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# MANUAL

OF

# OPERATIVE SURGERY

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BY

JOSEPH D. BRYANT, M.D.

PROFESSOR OF ANATOMY AND CLINICAL SURGERY, AND ASSOCIATE PROFESSOR OF ORTHOPEDIC SURGERY, BELLEVUE HOSPITAL MEDICAL COLLEGE; VISITING SURGEON TO BELLEVUE HOSPITAL, AND CONSULTING SURGEON TO THE NEW YORK LUNATIC ASYLUM AND THE OUT-DOOR DEPARTMENT OF BELLEVUE HOSPITAL.

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# OPERATIVE SURGERY.

## AMPUTATIONS OF THE LOWER EXTREMITY.

No better or more comprehensive statement can be made bearing on the duty of the surgeon in amputation of the lower extremity, than that "Under all circumstances, except where poverty, advanced age, and confirmed dissolute habits so combine in the individual as to render it certain that mechanical appliances would be of little service, give the patient the stump best adapted to the most useful artificial limbs. In all amputations of the lower extremity, the surgeon should be governed in the selection of the point of operation and the method to be adopted, (1) by the mortality of the operation in question; (2) by the adaptability of the stump to the most servicable artificial limb for locomotion."*

*Amputation of the Phalanges in their Continuity*, or through the articulations, is done by the same rules as those applied to amputations of the fingers. In the case of the toes, however, it is often difficult to open the joints on account of the changes induced in them, and in the contour of the bones, by the destroying influence of illy fitting boots and shoes. The flaps should be made from the plantar surface. In amputation of the metatarso-phalangeal articulation, remember the relation of the web to the joints in question, the former being a considerable distance below the latter (Fig. 332).

*Amputation of Single Toes* (*Disarticulation*).—They can be removed by the oval or lateral flap method. The former

* From report of Drs. Valentine Mott, Gurdon Buck, John Watson, A. C. Post, Willard Parker, Ernst Kracowizer, W. H. Van Buren, and Stephen Smith.

is the better, and is done by first grasping the condemned toe, while the assistant pulls aside its fellows. Commence over the joint, carry it downward along the side of the phalanx to be removed, beneath the toe through the line of the web. A second incision is then made of a similar extent and outline on the opposite side of the toe, down to the bone (Fig. 333); the ligaments and tendons are cut off and the bone removed by cutting from below. If the extremities of the divided tendons remain exposed, they should be pulled down and severed on a level with the divided sur-

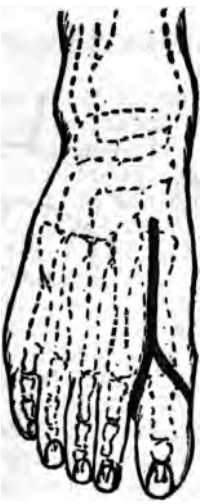

FIG. 332.

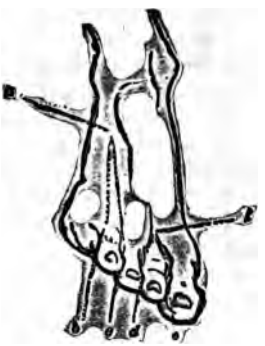

FIG. 333.

face of the soft parts. The removal of either the second, third, or fourth toes can be affected by making a transverse incision over the joint, and passing the knife through it and along the under surface of the bone a sufficient length to make the necessary plantar flap, which is turned upward and united. If it be required to remove the whole or part of the metacarpal bone of either of these toes, the incisions of the oval flap for disarticulation have only to be extended upward on the dorsal surface of the bone to be removed to the point of intended section.

The lateral flap is better for the disarticulation of the

great and little toes (Fig. 334), and is made by abducting the toe and entering the knife vertically between it and the contiguous toe, and cutting through the web till the line of articulation is reached, when the knife is turned outward from the median line of the foot, joint opened, blade passed through it, and the lateral flap made of sufficient length by cutting along the opposite side of the toe (Fig. 335) to be removed. The importance of the great toe as a lever in propelling the body, requires that amputation through the phalanges should be practised when possible. In the remaining toes, however, it is not a matter of so much importance.

The prominent head of the metatarsal bone of the great

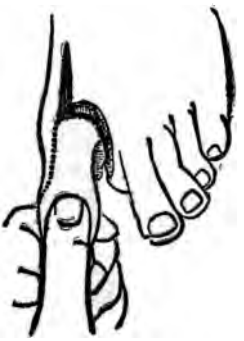

FIG. 334.

FIG. 335.

toe, which remains after disarticulation, has so frequently become the seat of painful bunions, that many surgeons of prominence advise that the bone be amputated behind its head by either a transverse or oblique section of its shaft. Of one fact there can be no doubt. If that portion of the boot or shoe in contact with this stump be not fitted and kept elevated by some means, the leather will quickly press upon it, causing great annoyance, and crippling the patient unnecessarily. The great toe can be amputated by a large square internal flap (Fig. 336). Begin the longitudinal incision at the outer side of the extensor tendon a little below the joint; carry it through the tissues down to the head of the first phalanx (surgi-cal); make a trans-

verse incision from the termination of this one around the inner side of the toe to a point opposite on the plantar surface; extend the toe and make another from the termination of the last towards the foot along the outer side of the tendon of the flexor longus pollicis to the web; connect this with the centre of the dorsal one by a transverse cut around the outer side of the base; dissect off the flaps; divide the ligaments and the remaining soft parts from within outward.

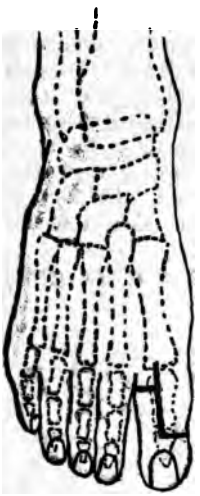

FIG. 336.

*Amputation of Two Adjoining Toes.*—Begin the dorsal incision between the metacarpal bones of the toes to be removed, just below the joint; carry it to the outer side of one of the toes, taking a good sized flap from it, thence through the digito-plantar fold to the outer side of the remaining toe, back to the point of starting. Remove each toe separately in the usual manner, and close the wound.

*Amputation of All the Toes at the Metatarso-phalangeal*

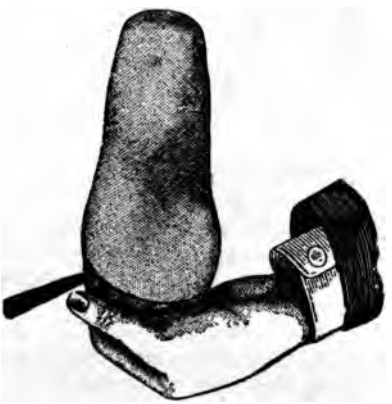

FIG. 337.

*Joint* (*Disarticulation*).—Forcibly extend the toes with the left hand and make a curved incision from the inner side

of the articulation of the great toe to the outer side of the corresponding joint of the little toe, carrying it through the groove between the sole of the foot and the base of the toes (Fig. 337). Flex the toes and join the first incision by a similar one across the dorsum (Fig. 338). Dissect up the flaps, expose the joints and remove each toe separately, allowing the sesmoid bones of the great toe to remain.

FIG. 338.

If the flaps be too short, the heads of the metatarsal bones should be cut off sufficiently to accommodate them, and divided surfaces united. When recovery takes place the foot presents the following appearance (Fig. 339).

*Amputation through all the Metatarsal Bones.*—This is best done by a short dorsal and a long plantar flap. Make the

plantar flap first, dissecting the tissues backward from the junction of the toes with the sole, to the point of amputa-

FIG. 339.

FIG. 340.

tion, down to the bones. A short dorsal flap is then made with the convexity downward, and the extremities united

to those of the preceding. Divide the interosseous tissues with a sharp, narrow-bladed knife; introduce a carbolized six-tailed retractor (Fig. 340), draw the soft parts upward, and divide the bones with a fine saw, and turn the flap upward and unite it in the usual manner.

*Amputation of the Great Toe, with its Metatarsal Bone.*—This is best done by the oval method, being similar to that

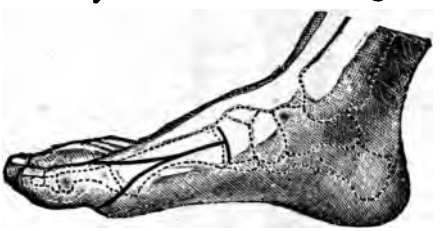

FIG. 341.

for removal of the thumb (Fig. 341). It is recommended, on account of the width of the base of the metatarsal bone, to make a short transverse incision across it at the joint; remove the flap, thereby exposing the whole length of the bone; open the joint on the dorsal aspect, separate its remaining connections, and remove it.

*Amputation of the Fifth Toe, with the Metatarsal Bone.*—

FIG. 342.

This can be done by either the oval or flap method. The steps of the former being in all respects substantially similar to the removal of the great toe.

The flap method is done by separating the fifth from the fourth toe, at the same time carrying a narrow-bladed knife upward between the metatarsal bones from the web, until it is obstructed, when the knife is withdrawn and the

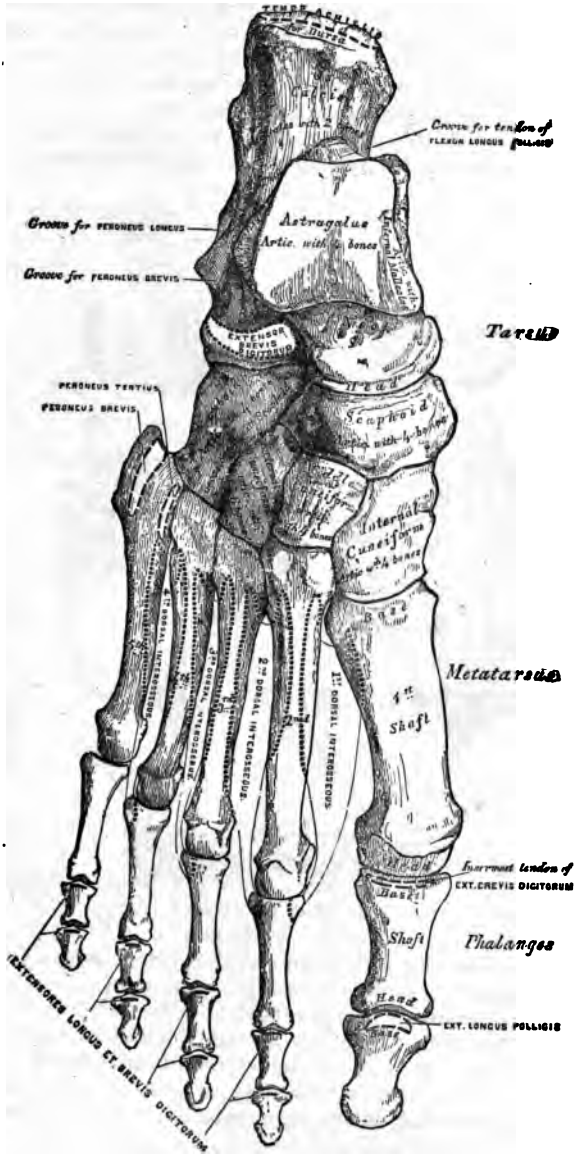
Groove for FLEXOR LONGUS POLLICIS
Groove for PERONEUS LONGUS
Groove for PERONEUS BREVIS
Astragalus
Artic. with 2 bones
EXTENSOR BREVIS DIGITORUM
Tarsus
PERONEUS TERTIUS
PERONEUS BREVIS
Scaphoid
Internal Cuneiform
Metatarsus
1st DORSAL INTEROSSEOUS
2nd DORSAL INTEROSSEOUS
4th Shaft
Base
Head
tendon of EXT. BREVIS DIGITORUM
Shaft
Phalanges
Head
EXT. LONGUS POLLICIS
EXTENSORES LONGUS ET BREVIS DIGITORUM

FIG. 343.

incision prolonged upward on the dorsal and plantar surfaces in a straight line about one inch. Strongly abduct the metatarsal bone to be removed, separating it from its fellow and from the cuboid; carry the knife around the base to the outer side, and so on downward to the metatarso-phalangeal articulation (Fig. 342); remove the bone, and the tongue-shaped flap just made will fit the inter-metatarsal incision.

*Amputation at the Tarso-metatarsal Joints* (Lisfranc's).—It will very much expedite matters, save considerable annoyance to the operator, and preserve the edge of his knife,

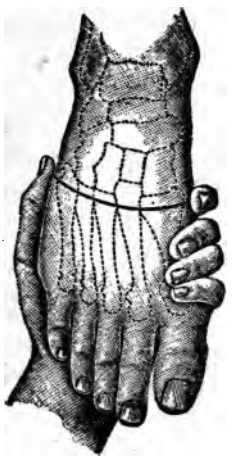

FIG. 344.

FIG. 345.

if the relations of the bones entering into the joints be fully noted before attempting to open them (Fig. 343). The articulation between the cuboid and the fifth metatarsal is seen to be to the inner side of the outer tuberosity.

The joint of the internal cuneiform and the metatarsal bone of the great toe is about an inch and a half in front of the tuberosity of the scaphoid.

In every instance these joints should be carefully located. Raise the foot and mark out a large semilunar flap on the plantar surface, the base of which shall correspond to the distance between the joints just indicated, and its distal extremity, to the heads of the metatarsal bones. Extend the

foot, and make a short dorsal flap with the convexity forward, and its base corresponding to that of the plantar flap (Fig. 344). Draw the small dorsal flap upward, and commence the disarticulation on the outer side of the tarsus; strongly extend and adduct the bones, which will better mark the outlines of the articulation; separate the fifth, fourth, and third articulations; skip the second and open the first. The articulation of the second with the cuneiform bones is peculiar, in that it is about two fifths of an inch higher; however, with the bones depressed, a short transverse incision liberates its dorsal connections with the middle cuneiform (Fig. 345), after which it is disconnected from the internal and external cuneiform bones, as well as its contiguous metatarsal, by cutting upward

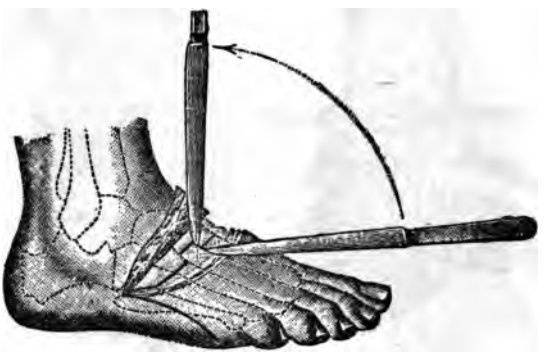

FIG. 346.

(Fig. 346). Open the joint well, divide the ligaments on the side and plantar surface, carry the knife along the sole and make the plantar flap as previously laid out (Fig. 347). If all the muscular tissues of the sole be removed, it will be too bulky; a part should therefore be omitted from it. The plantar flap may be made by transfixion, before the articulations are opened.

This cannot be recommended, however, as the flaps thus formed must await the completion of the operation without facilitating it. Moreover, if the plantar flap be made by transfixion, before disarticulation, the transverse arch of the foot will be intact, causing the centre of the flap to be made thin, since the knife cannot come sufficiently close to other

than the first and fifth metatarsal bones. After the removal of the part, the stump appears as seen in Fig. 348. This method has been variously modified, the modifications, in some instances, becoming confused with the original method. Hey sawed off the projecting portion of the internal cuneiform; this, however, is not expedient, as it lessens the attachment of the tibialis anticus and shortens the leverage of the foot.

Skey sawed off the base of the second metatarsal, leaving it in the mortise.

This adds nothing to the usefulness of the stump, and exposes the remaining fragment to the danger of necrosis.

FIG. 347.

FIG. 348.

Baudeus proposed that the first metatarsal bone only should be disarticulated, and the remaining ones sawn off transversely on a level with the internal cuneiform.

The rate of mortality in amputation of the toes is about 6.5 per cent.

*Amputation through the Medio-tarsal Joint* (Chopart's). —The medio-tarsal joint is formed by the astralagus and os calcis behind, and the scaphoid and cuboid in front.

Their articulation can be indicated by drawing a transverse line across the dorsum of the foot, beginning just behind the tuberosity of the scaphoid; the outer extremity will be about one inch behind the tuberosity of the fifth metatarsal bone. The foot is raised and a curved initiatory incision is carried over the sole, extending from the

mark on the inner side indicating the articulation of the scaphoid with the astragalus (Fig. 349), forward to within a thumb's breadth of the heads of the metatarsal bones (Fig. 350), across the sole and backward to the outer line indicating the articulation of the cuboid and os calcis (Fig. 351). Forcibly extend the foot and make a slightly curved incision, through the skin only, the convexity downward, across the dorsum, connecting the upper extremities of the plantar incision (Fig. 352). Turn the dorsal flap upward, open the joint on the dorsal surface; beginning from within, bend the metatarsal bones towards the heel, and sever the ligamentous connections thus made tense. Finally pass the knife through the articulation to the plantar surface, turn the edge towards the toes, and complete the plantar flap (Fig. 353). Fig. 354 represents the stump after the flaps are united.

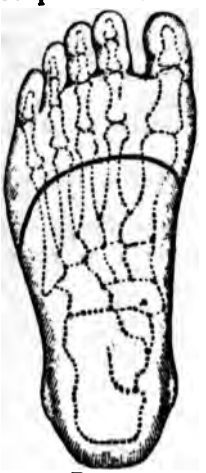

FIG. 350.

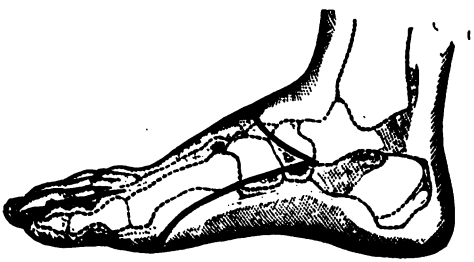

FIG. 349.

FIG. 351.

FIG. 352.

This operation is objected to on account of the liability of the stump to become tipped up, causing the patient to walk on the cicatrix at its anterior extremity. The division of the tendo-Achillis at, or subsequent to the operation is done to counteract this tenden cy; but frequently, how-

FIG. 353.

ever, without success. This operation cannot be recommended as a substitute for those that are to follow, in point of comfort and usefulness. Better execution is done with an artificial limb-appliance in the Syme's amputation than in this. The mortality is about eight per cent.

*Forbes's Amputation.*—This is done through the same incisions as Chopart's. After the cuneiform bones have been separated from the scaphoid, the cuboid is sawn through on a line with them. Inasmuch as this operation offers no additional power of flexion by reason of its muscular attachments, its stump will become subjected to the same annoyance as the former.

FIG. 354.

In this, as in the medio-tarsal, the after-treatment exercises a most important influence upon the results.

*Sub-astragaloid Disarticulation* (Malgaigne).—Make two lateral flaps by an incision beginning immediately above the tuberosity of the os calcis on the outer side, which divides the tendo-Achillis, and is carried along the outer side of the os calcis in a curved manner,

FIG. 355.

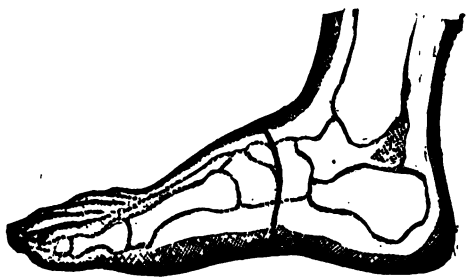

FIG. 356.

convexity downward, below the external malleolus, thence extending obliquely upward across the middle of the cuboid to the dorsum of the foot (Fig. 355); then vertically downward across the inner border of the scaphoid (Fig. 356) till it reaches the centre of the sole of the foot; it is then turned directly backward at a right angle with the preceding cut, and joins the beginning of the incision at the inner border of the tendo-Achillis (Fig. 357).

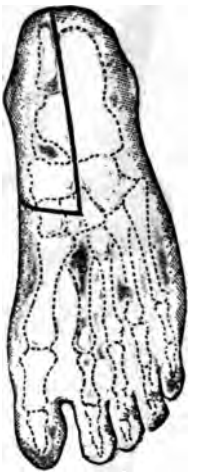

FIG. 357.

Elevate both flaps till the lateral surfaces of the os calcis and the talo-scaphoid joints are exposed, being careful not to injure the tibia-tarsal joint; remove the bones in front of the medio-tarsal junction; seize the anterior extremity of the os calcis with bone forceps; depress and supinate it, and divide the external lateral ligaments with a narrow knife about a third of an inch below the tip of the malleolus; then divide the interosseous ligament between the os calcis and astragalus; finally, the talo-calcanean ligament is divided an inch below the internal malleolus (Fig. 358). The os calcis is then removed

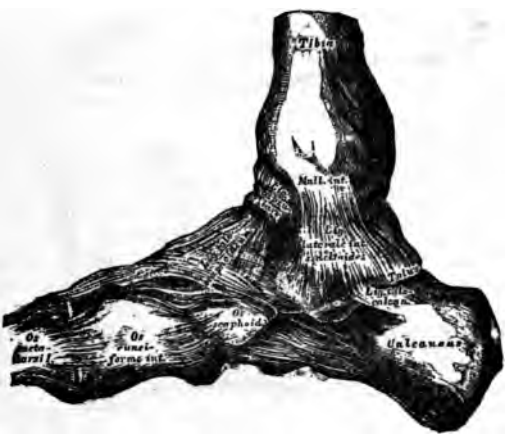


FIG. 358.

(Fig. 359) and the flap united in position. Fig. 360 shows the appearance of the stump after union of the flaps. Over

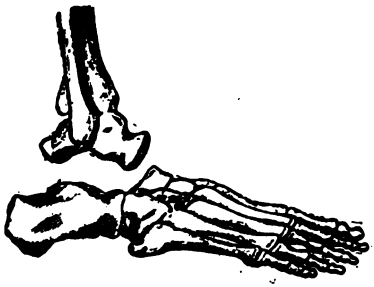

FIG. 359.

twelve per cent are reported to have died from the operation alone.

FIG. 360.

*Hancock's Amputation.*—This may be considered a combination of the sub-astragaloid and Pirogoff's method. The operation can be done through incisions similar to the latter; the flaps, however, being made somewhat longer. Saw the os calcis as in Pirogoff's method. Make a transverse section of the astragalus; remove it, along with the associated fragment of the os calcis, and bring the sawn surfaces of the remaining portion of the os calcis in contact with the under surface of the articulated portion of the astragalus.

*Tripier's Method.*—This method consists of a single oval-shaped flap; its forming incision commencing at the outer side of the tendo-Achillis, and, passing forward, below the outer malleolus, encircling the foot opposite to the tarso-metatarsal joint. The flap is reflected upward to the medio-tarsal articulation, and the portion of the foot in front of it removed. The periosteum is then removed by the elevator and scalpel from the posterior portion of the os calcis below the sustentaculum, at which point that bone is sawn through at a right angle with the vertical axis of the leg. The tendons are divided as high

as practicable, wound united and treated in the usual manner. The *results* of amputation of the foot show a death rate of about twenty-three per cent.

*Amputation at the Ankle—Amputation of the Entire Foot* (Syme's).—This can be considered one of the most practical of the operations of the foot and ankle. It not only is

FIG. 361.

followed by a small rate of mortality, but also by a most serviceable stump, either with or without an artificial appliance. The patient should be placed upon a table, with the leg overhanging it; the thigh raised by an assistant, who at the same time flexes the condemned foot

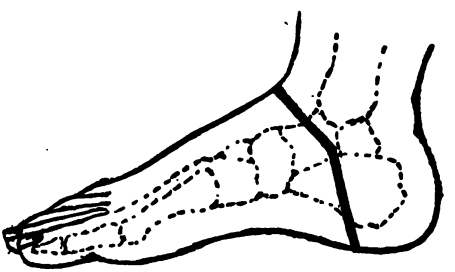

FIG. 362.

upon the leg, by seizing and pulling upward on its anterior portion. The outlines of the respective flaps should now be carefully drawn before the incisions are commenced. The line indicating the proper course of the plantar incision should begin at the apex of the external

malleolus—for left side—and, with a backward inclination, pass around the foot (Fig. 361) to a point opposite to its beginning, which is about a finger's breadth below the centre of the apex of the internal malleolus (Fig. 362).

The second or dorsal line is drawn directly across the instep, and connects the extremities of the plantar incision. The surgeon should select a scalpel of large size and with a strong shank, and insert the point at the commencement of the incision down to the bone at a right angle to its

FIG. 363.

FIG. 364.

outer surface, with the edge undermost; carry it along the guiding line in contact with the bone to its inner extremity. Place the fingers on the heel and the thumb within the cut, and draw firmly backward on the posterior flap, at the same time liberating it from the outer surface and sides of the os calcis, back to near the insertion of the tendo-Achillis. An incision is now made down to the bone on the anterior line, and the joint opened in front; the foot well extended, lateral ligaments divided, and foot removed by liberating the remaining tissues attached to the posterior surface of

the os calcis, including the tendo-Achillis, always remembering to closely hug the bone, else the flap may be cut and its integrity impaired. After the removal of the foot, dissect up the soft parts around the malleoli a sufficient distance to permit the bones to be sawn off (Figs. 363 and 364); pull down and cut off the extremities of the various tendons, bring the flap into position, unite it in front, and dress with antiseptic precautions (Fig. 365).

*Modifications.*—Sawing the malleoli obliquely (Fig. 367), instead of removing them along with a thin transverse sec-

FIG. 365.

FIG. 366.—SIDE VIEW.

tion, including the articular surface of the tibia, as recommended by Mr. Syme, is a modification which has been long and somewhat extensively practised. It is believed to give a better-shaped stump, and to be attended with less danger to life than if the bony canals of the tibia be extensively opened, as in the case of transverse section.

Many surgeons, after making the plantar incision, open the joint in front, as before described, disarticulate and dissect the heel-flap from behind forward.

This affords more room and leverage to aid in the

removal of this flap, but increases the danger of cutting it. The removal of the periosteum from the posterior surface and the sides of the os calcis, along with the insertion of the tendo-Achillis, has been practiced. If it can be done without too much laceration of its structure, it is a commendable modification.

FIG. 367.

By some the articular cartilage remaining on the extremity of the tibia is scraped off; this act is thought to hasten the healing process. Many methods have been devised to modify the construction of the flaps to cover the end of the stump, adapted to various forms of injury to the soft parts. When the heel-flap is impossible, tissues can be taken from all or either of the three remaining aspects of the foot to supply it; being ever cautious to avoid injuring the posterior tibial, as it lies below the inner malleolus.

*Results.*—The rate of mortality from Syme's operation is about ten per cent.

*Fallacies.*—The incision across the instep lies below the line of articulation between the astragalus and the tibia. Therefore, unless care be taken to locate the joint, the operator will cut down upon the neck of the astragalus, and, not finding the joint, will become much confused; or he may even open the articulation between the scaphoid and astragalus. If the plantar flap be made too long, it will be impossible to carry it over the point of the heel. Therefore, if it be necessary to make a long heel-flap, the joint should be opened at once and the heel-flap dissected off from before backward.

*Roux's Operation.*—Begin the incision at the outer side of the tendo-Achillis, a little above the insertion; carry it straight forward beneath the outer malleolus (Figs. 368 and

369), then in a curved line across its instep, half an inch in front of the articular edge of the tibia backward and downward, in front of the inner malleolus, to the sole; then

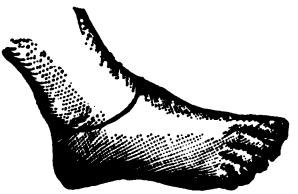

FIG. 368.

FIG. 369.

obliquely backward to near its outer border; then backward and upward over the heel to the point of beginning.

*Pirogoff's Amputation.*—This is osteo-plastic in character,

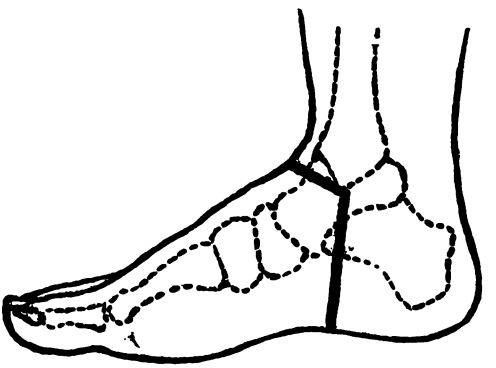

FIG. 370.

and consists in the application of the sawn surfaces of the posterior portion of the os calcis to the like surface of the bones of the leg. The length of the limb is well preserved, and, without the use of an artificial appliance, the stump is often superior to that of Syme. Flex the foot at a right angle with the leg; make an incision down upon the bone,

from the tip of the internal malleolus directly across the sole, its lowermost portion being a little in front of the long axis of the tibia (Fig. 370), around the foot to a point in front of the apex of the external malleolus (Fig. 371).

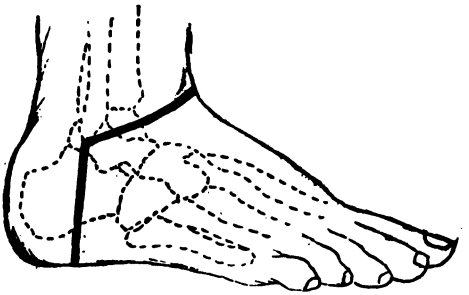

FIG. 371.

The extremities of these are connected by another carried down to the bone, half an inch in front of the lower extremity of the tibia. Open the joint in front, divide the lateral ligaments, disarticulate the head of the astragalus (Fig. 372), and with a narrow saw divide the os calcis obliquely downward and forward in the line of the plantar incision. Raise the anterior flap, dissect up the tissues around the lower ends of the bones, and saw through the lower extremities of the tibia and fibula, just above their articular surfaces. If any of the divided tendons be below the edges of the wound, draw them down and cut them off on a level with it.

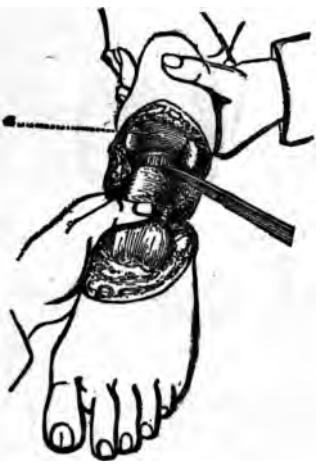

FIG. 372.

The cut surface of the os calcis is then brought forward and placed in contact with that of the tibia; the wound united in front, and dressed antiseptically.

*Fallacies.* — If the posterior border of the os calcis be cut too long, the divided bone surfaces cannot be properly apposed; or, if so, with difficulty, causing the fragment to

tilt backward. This can be remedied by removing more from the border, or, if slight, by dividing the tendo-Achillis. Whenever this tendon inclines to tilt the bone, it should be divided. To increase the security, the fragment can be united by silver wire. The os calcis has been sawn at different angles to that bone (Fig. 373), but the one just considered has given the most satisfactory results. Fig. 374 shows the appearance of the stump after Pirogoff's operation.

*Results.*—The death rate from this operation is a little in excess of ten per cent.

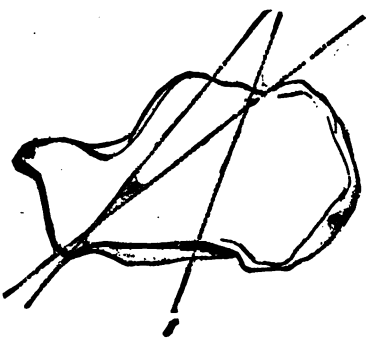

FIG. 373.

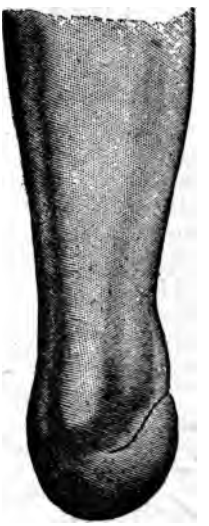

FIG. 374.

*Modification of Pirogoff's Operation.*—Fergusson's modification consists in not removing the malleoli, except they are diseased, but dividing the tendo-Achillis, placing the sawn end of the os calcis between them. Dr. Turnipseed and others have practiced this modification and recommend it.

*Le Fort's Modification.*—The incisions for the flaps are similar to those in Roux's modification of Syme's amputation. The ankle joint is exposed by raising the dorsal flap; keeping close to the bone to not injure the posterior

tibial artery. Divide the external lateral ligament, also those between the astragalus and os calcis. Cause the foot

FIG. 375.

FIG. 376.

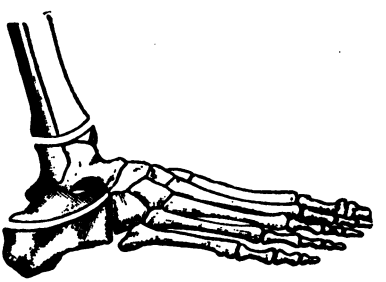

FIG. 377.

to turn inward, and remove the anterior portion at the medio-tarsal joint. Seize the astragalus with strong for-

ceps; make tense the ligaments connecting it with the bones above, which are cut and the bone removed. Push

FIG. 378.

down the os calcis, and with a narrow saw remove its upper third from behind forward, beginning just above the

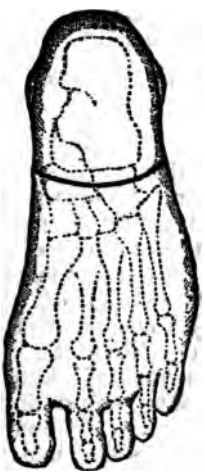

FIG. 379.

FIG. 381.

insertion of the tendo-Achillis. Saw off the malleoli and articular surface of the tibia, as in Pirogoff's operation

(Fig. 375). Place the sawn surfaces in apposition, and dress in the usual manner. This modification permits the reserved fragment of the os calcis, when placed in position, to maintain the same relative axis to the end of the stump that it held to the foot; consequently receiving the direct pressure upon the integumentary covering already adapted to the purpose (Fig. 376).

*Bruns* recommended that the sawn surfaces of the os calcis be made concave, and the tibia convex (Fig. 377).

*Esmarch's Modification* of Le Fort's operation consists of two incisions: one across the sole, the other across the dorsum of the foot. The former commences about four fifths

FIG. 380.

of an inch below the tip of the external malleolus, and with the convexity forward (Fig. 378), runs under the cuboid and scaphoid bones (Fig. 379), ending at the inner side, one inch below and in front of the internal malleolus (Fig. 380). The curved dorsal incision, with its concavity forward to the tuberosity of the scaphoid, connects the extremes of the plantar one (Fig. 381). Dissect up the dorsal flap to the tibio-tarsal joint, which should be opened; foot bent backward, and the upper surface of the os calcis exposed sufficiently to apply a small saw behind the upper margin of the tuberosity of the os calcis and the bone sawn, as before described (Fig. 375). The flaps are then united, drained, and dressed antiseptically.

## AMPUTATIONS OF THE LEG.

*Supra-malleolar Amputation.*—This operation approaches more nearly to Syme in location than any other that can be performed upon the leg, but owing to the comparatively high rate of mortality resulting, it is not to be recommended in preference to a higher amputation. The flaps must always be made from the firmest and best nourished tissues accessible.

Two semilunar incisions, one external and one internal, are made, each beginning posteriorly at the posterior border of the malleoli, and passing forward beneath them, and around upon the anterior surface or dorsum of the foot, an inch in front of the ankle joint, where they join each other. Their posterior extremities are then united by a transverse incision, with the convexity downward. The flaps are dissected upward, and the bones of the leg divided transversely about an inch above the articular surfaces.

*Amputations of the Leg at the Lower Third.*—When possible, the leg should always be amputated at this situation. It gives a long fulcrumage for an artificial limb, admits of the formation of a symmetrically tapering stump, which can be closely adjusted to the socket of the artificial appliance.

Three methods can be employed: circular, bilateral, and hood flaps, embracing only the integument and subcutaneous tissues, along with the periosteum covering the subcutaneous surface of the tibia.

*Circular Method with Periosteal Reflection.*—If the situation can be selected for the site of the operation, it should be three or three and a half inches from the lower extremity of the tibia; or, more definitely, at the point where the tapering of the limb from above downward ceases. The length of the flap should be equal to a fourth of the circumference of the limb at the proposed point of section.

Prepare the patient in the usual manner; make a circular incision through the integument and subcutaneous tissue down to the muscular fascia and the subcutaneous surface of the tibia. Dissect the sleeve for about an inch all around, then divide the periosteum on the subcutaneous surface of the tibia by a transverse incision, located at the point of reflection of the flap; divide it also at the outer and inner borders of the surface of the tibia a sufficient distance (one

fourth of an inch) to allow the periosteum to be reflected upward while attached to the inner surface of the flap. These longitudinal incisions are repeated as often as it becomes necessary to detach the periosteum in keeping pace with the turning up of the flap at the remaining portions of its circumference. That is, instead of dissecting the flap from the tibia, its periosteum is detached from its subcutaneous surface and pushed up to the point of proposed

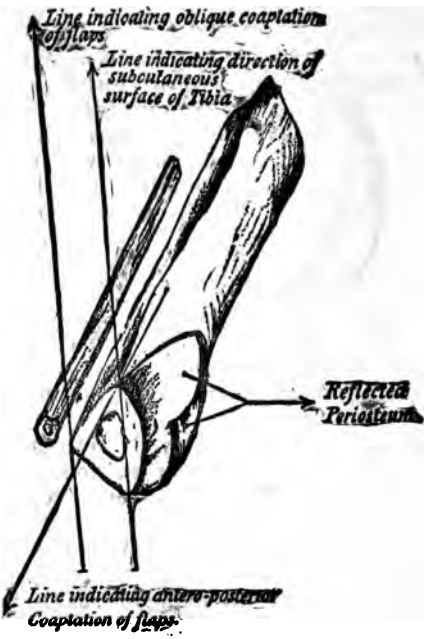
Line indicating oblique coaptation of flaps
Line indicating direction of subcutaneous surface of Tibia
Reflected Periosteum
Line indicating antero-posterior Coaptation of flaps

FIG. 382.

section, while still adherent to and forming a limited lining to the flap. Fig. 382 shows the extent of the reflection of the periosteum, which, however, in the operation remains attached to the inner surface of the corresponding portion of the flap. The tibia is sawn carefully through at the point of the periosteal reflection, the fibula exposed one fourth of an inch higher and divided separately by sawing towards the tibia. The flaps are then united obliquely, so

that not only will the line of union fall between the two bones, but that which is more important, the periosteal lining of the inner portion of the flap will fall and lie

FIG. 383.

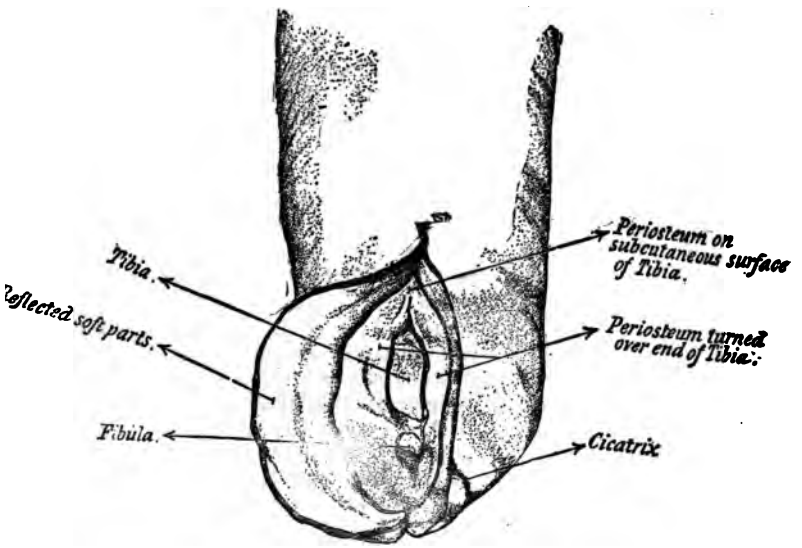


FIG. 384.

smoothly across the divided extremity of the tibia, since the subcutaneous surface of the tibia lies parallel with the line of oblique coaptation. (See Fig. 383.) It will be necessary, in order to reflect the sleeve flap, that it be divided longitudinally; this should be done at the point that will become lowermost when the flaps are obliquely joined. The limb should be dressed antiseptically, using caution to maintain the oblique direction of cicatrix till the healing process is complete. The periosteal flap grows to the end of the bone, preventing its becoming atrophied, and likewise prevents the adhesion of the cicatrix to the end of the tibia. Fig. 384 shows a longitudinal section through the flap three months after this operation had been done.

*The bi-lateral flap method* (Fig. 385) consists of equi-lateral flaps constructed from the integument and subcutaneous tissue at the outer and inner surface of the limb. They can be made either with or without the periosteal lining. The circular with oblique coaptation is by far the better if the periosteum be raised; since in antero-posterior coaptation the periosteal flap will be tilted, and become more liable to eversion and the production of bony spicular growths.

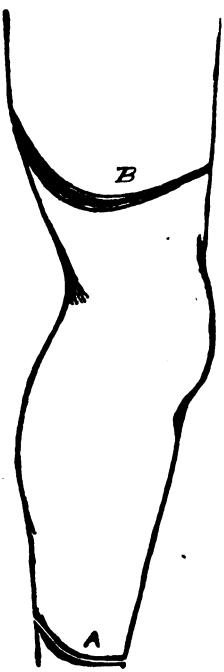

FIG. 385.

The bi-lateral flaps are made by first ascertaining the circumference of the limb at the point of the proposed amputation. The base of each flap is then made equal to half, and the length to one fourth of this circumference. Each one is nearly semicircular, and their points of juncture should be at the centre of the limb, anteriorly and posteriorly, which will bring the anterior point of union to the inner side of the crest of the tibia; also, it should be a little below the point of the proposed section of the tibia bone. The posterior point of junction should be above that of the anterior, to provide for suitable drainage. (Fig. 385, A.) When properly outlined each flap is dissected upward

to near the point the bone is to be divided; the muscles are cut by a circular incision, pushed upward above the anterior point of union of the flaps, and the bones sawn off, with the fibula a fourth of an inch the shorter, corresponding to the junction of the flaps posteriorly. If there be an undue amount of muscular tissue behind, it can be trimmed off until it admits of the ready union of their divided borders. Suitable drainage, antero-posterior coaptation, and an antiseptic dressing completes the immediate attention to the case.

*Hood, or oval flap method*, is a modification of the circular, the skin cuff being slit up posteriorly to the point at which the bone is to be divided, and the corners trimmed off to resemble the outlines of the lower portions of the bi-lateral flap. This flap is then reflected upward, and the muscles and bones divided as before. The line of union is made antero-posteriorly.

The advantages claimed for this method are: Its perfect drainage; the location of the cicatrix on the posterior surface; the carrying of the integument over the end of the bone prevents the adhesion of the cicatrix to it. Like the bi-lateral, it can be employed in connection with the periosteal flap; still, as it is joined to form an antero-posterior line of union, it is open to the same objections as the former with reference to the periosteum.

*Results.*—The rate of mortality from amputation in the lower third is variously estimated from 13 to 22 per cent; this being, however, less than at any other part of the limb.

*Amputation through the Middle Third.*—The limb can be amputated at this point by the same methods employed below. The principles applicable to the lower third have an equal force at this situation. The presence of the calf offers an additional difficulty in obtaining the oblique coaptation, but does not interpose an insurmountable objection to it. Care in dressing the stump will maintain the obliquity of the line of coaptation in the periosteal flap method. The bi-lateral and hood flap methods, either with or without the periosteal lining, present to the surgeon the means of making a most serviceable stump. If other than the preceding be desired, the long external and short internal flaps are to be preferred, instead of either long anterior or posterior; since the latter impedes drainage, and by the weight of the posterior exerts undue traction across the crest of the tibia.

*Uni-lateral flap method*, combined with a semicircular incision on the opposite side, offers good drainage, and carries the cicatrix beyond the point of pressure.

These flaps may be muscular or integumentary; the former are made by transfixion, the latter by external incision with the ordinary scalpel and circular section of the muscles with the long knife. The principles controlling the length of the flaps are the same as previously stated. The long flap should be made from the outer side of the leg, having a base somewhat less than one half the circumference of the limb. The inner, or short flap, is semicircular in shape (Fig. 386). The bones are sawn off just above the anterior point of junction of the flaps, which are united, and the wound dressed as before.

FIG. 386.

The rate of mortality of amputations for this portion of the limb are about 27 per cent.

*Amputation at the Upper Third.*—Either of the methods employed in the middle third is applicable at this situation. The fibula should not be removed, as the superior tibio-fibular articulation sometimes communicates with the knee joint. The tibia is sawn below the insertion of the ligamentum patellæ. The mortality is about 43 per cent.

*Amputation at the Knee Joint* (*Disarticulation*).—The bi-lateral, circular, long anterior, and hood flaps constitute the ones best intended to meet the indications. The stump resulting from either has an early sustaining power with a broad point of support, which later in life becomes somewhat lessened in size. The joint surface should not be molested, other than scraping off the articular cartilage.

The patella, unless diseased, is allowed to remain. It will be found to rest just above the condyles, where it affords a good point of attachment for the quadriceps extensor. The ligaments should be divided close to the femur, the semilunar cartilages remaining attached to the tibia. The popliteal artery should be tied, only after suffi-

cient isolation to admit of the application of the ligature above the articular branches. The popliteal vein also should be isolated and tied.

*Bi-lateral Method.*—This, without doubt, is the best method. It provides for two well-nourished flaps, which when united locate the cicatrix between the condyles posteriorly, thereby affording admirable drainage.

*Operation.*—With the thigh elevated and the leg extended, begin the anterior incision of either flap, one inch below the tuberosity of the tibia, cutting through the skin and subcutaneous tissues. Carry it downward and forward below the curve of the leg, thence inward and backward to the middle of the under surface of the leg, then directly upward to the middle of the popliteal space. The opposite flap is made in a similar manner; remembering, however, that the flap at the inner side must be made the longer, on account of the greater length and size of the inner condyle. Raise the flaps until the articulation and apex of the patella are reached; divide the ligamentum patella; open the joint in front; draw the head of the tibia forward and pass a long knife behind it; extend the leg somewhat and cut the remaining tissues directly downward. Before severing these tissues be careful to ascertain if perfect control be had of the femoral artery. After removal of the leg the stump presents the appearance as shown in Fig. 387. The flaps are united and suitable drainage provided. A not infrequent sequel to this operation is the formation of an abscess beneath the quadriceps extensor, due to the collection of pus at the upper end of the synovial pouch of the joint; the elevation of the stump causing it to gravitate to that point. This can be avoided by the division of the lateral synovial bands commanding the entrance to it; and the introduction of a drainage tube to the uppermost portion; or by carrying the tube through the uppermost extremity to the anterior surface of the thigh. Sometimes compression firmly and continuously applied will answer the purpose. When healed the stump presents the appearance shown in Fig. 388.

FIG. 387.

*Fallacies.*—It has, however, one fallacy, which has been the cause of much chagrin to surgeons on rare occasions. The danger of making the flaps too short, followed by the necessity of removing the patella, or sawing off the condyles before the flaps can be properly united.

FIG. 388.

*Circular Method.*—Extend the leg and make a circular incision around it, about four inches below the patella, through the integument and subcutaneous tissues. Dissect it up to the edge of the patella; flex the leg and divide the ligamentum patella at its apex; also open the joint in

FIG. 389.

front, divide the lateral ligaments close to the femur, so that the semilunar cartilage, as before, will remain connected with the tibia. Flex the leg and cut the crucial ligaments. Pass a long knife between the bones, extend the leg, and sever the posterior connections as before (Fig. 389).

The flaps can be united from before backward, or transversely, the former being the better for obvious reasons (Figs. 390 and 390*a*).

*Long Anterior, with Short Posterior Flaps.*—Flex the leg

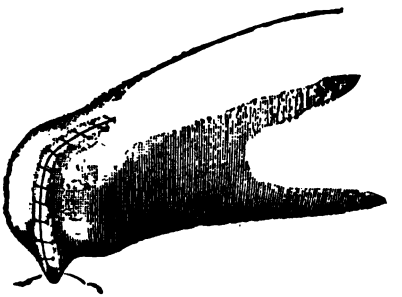

FIG. 390.

and make a longitudinal semicircular-shaped flap; beginning a little below the centre of the inner surface of the one condyle, extending around in front five inches below the patella to a similar point on the external condyle (Fig. 391). Dissect the flap upward to the patella, open

FIG. 390*a*.

the joint as before; draw the head of the tibia forward and pass a long knife behind it, making the short posterior flap from above downward, beginning the incision at the extremities of the anterior flap. When united the cicatrix is well protected and good drainage afforded (Fig. 392).

The rate of mortality from amputation through the knee-joint varies but little from amputations of the lower limb,

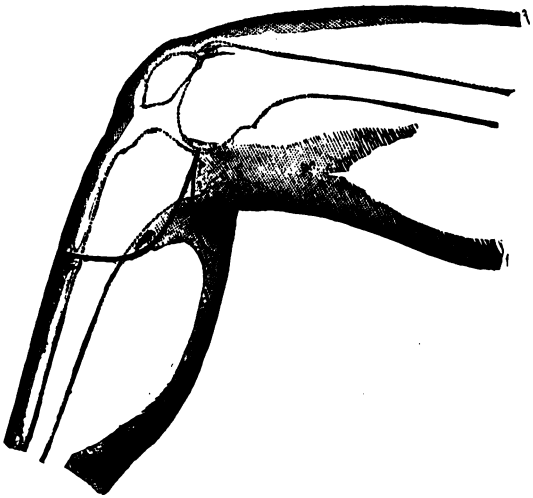

FIG. 391.

as a whole, averaging in the latter about 34 per cent; in the former 32. Amputation through the knee-joint offers a better chance for life than through the upper third of the leg.

FIG. 392.

*Hood Flap.*—This varies but little from the bi-lateral; having a somewhat oval outline in front, instead of a retiring angle.

*Amputation through the Condyles.*—This operation possesses no advantage over the one through the articulation.

The difference in the rate of mortality is somewhat increased, and the usefulness of the stump is decidedly in favor of the latter. However, as conditions sometimes arise rendering the latter impracticable, the former becomes a valuable expedient.

*Carden's Amputation.*—Extend the leg, seize the joint with the left hand, the end of the thumb and index finger resting as nearly as possible at the centre of each condyle.

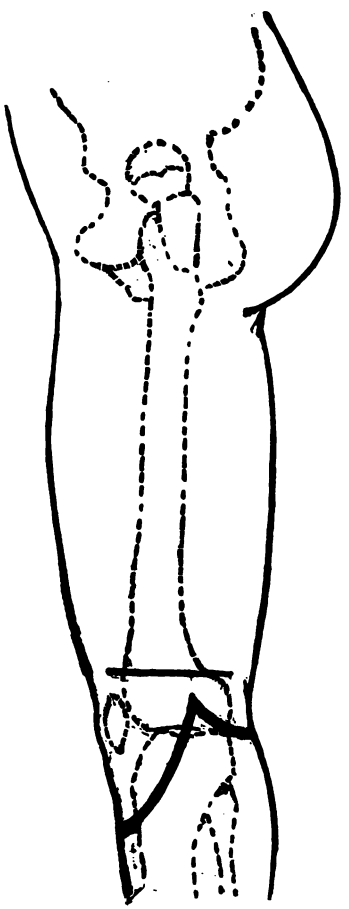

FIG. 393.

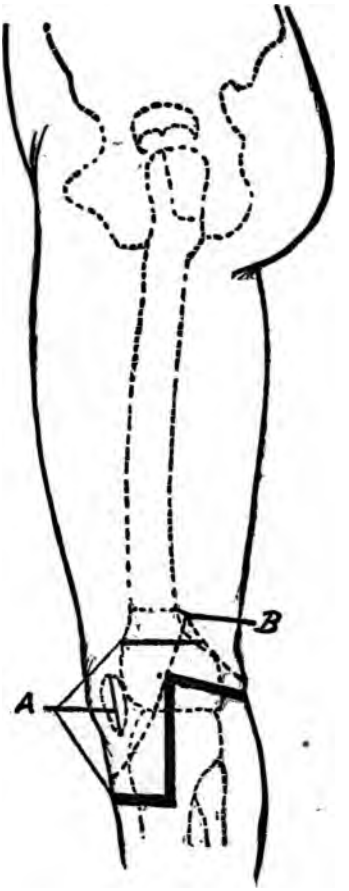


FIG. 394.

With a stout scalpel make an anterior semilunar flap, commencing at the end of the index finger, passing around in front about two inches below the patella to the end of the

thumb on the opposite side. If the question of amputation or exsection be undecided, reflect the anterior flap first; otherwise, connect the extremities of the anterior flap by a short posterior one carried directly down to the bone (Fig. 393). Reflect both flaps upward to the base of the condyles; flex the leg to draw down the patella, and divide the remaining tissues surrounding the condyles down to the bone; then saw off the condyles at their base, secure the vessels as before described, and unite the divided parts. The rate of mortality as reported by Carden was a little in excess of sixteen per cent.

*Gritti's Amputation*, A.—Extend the leg and make a rectangular flap, extending from the centre of the condyles to the tuberosity of the tibia (Fig. 394). Divide the ligamentum patellæ at its insertion and dissect up the flap containing it. Divide the integument on the posterior surface by a circular incision. Remove the synovial membrane from its attachments to the femur in front, and saw the bone just above the articular cartilages. Introduce a long knife and cut the remaining tissues from within outward. Saw off the articular surface of the patella, allow the anterior flap to fall into position, causing the sawn surface of the patella to come in contact with the divided end of the femur. This operation is osteo-plastic in character, being allied to Pirogoff's.

*Stokes' modification* of Gritti's method consists in making an anterior oval instead of a rectangular flap. The posterior flaps being made one third its length; and the femur is sawn off an inch above the condyles, instead of through their base (Fig. 394, B.) The patella is sawn and united to the extremity of the femur by passing strong cat-gut through the soft tissues immediately behind the bone.

The rate of mortality for Gritti's operation, and Stokes' modification is about thirty per cent.

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## AMPUTATIONS OF THE THIGH.

The muscles surrounding the thigh are of large size and many of them of great length. Those on the posterior and many on the anterior surface extend from the pelvis to the leg. On the inner side the length is but little less and the bulk is increased.

The greater the length of a muscle from its origin to the point of its division, the more marked will be its retraction, other things being equal. It therefore happens, in amputation of the thigh, unless care be exercised to allow for the greater degree of contraction of the long muscles, that the bone protrudes, or presses too strongly against the flap, giving it an undue conicity, or otherwise distorting the stump. The position in which the limb rests during the

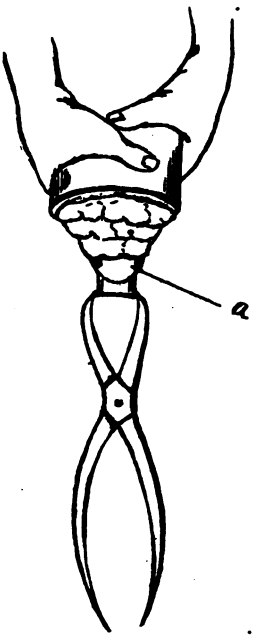


FIG. 395.

healing process has an influence on the muscular retraction. For instance, if the limb be extended during the division of the muscles, the posterior ones, on account of their greater length, retract the most, and if to this be added the additional retraction due to placing the stump in a semi-fixed position—on a pillow, or by swinging—during the healing process, the tendency to cause tender, painful, and otherwise troublesome stumps is increased. To avoid this the limb, when the muscles are being divided, should be

held as nearly as possible at the same angle with the body as that in which it will be placed when the dressing is completed and during the process of recovery.

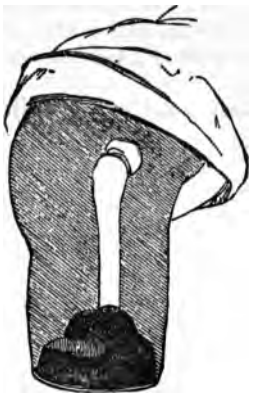

FIG. 395a.

FIG. 396.

In all amputations of the thigh an anterior rectangular or oval periosteal flap should be made, its outer surface remaining associated with the tissues connected with or

springing from it (Fig. 395*a*). If an amputation be made close to the band of a tourniquet or the elastic bandage of Esmarch, the muscles will be held too firmly to admit of the natural retraction until after the bone is sawn and they are liberated; this is a fault which should be recognized and corrected by cutting the muscles lower than would otherwise be done.

In the circular division of the muscles, accompanied by

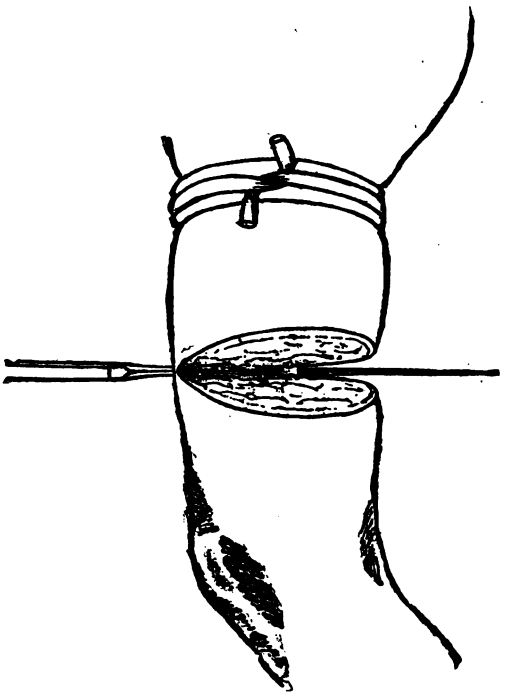

Fig. 398.

the circular or equi-lateral flaps, it is advisable that the first sweep of the knife should divide only the superficial layer, which will then retract or can be drawn upward and the second layer be severed at a higher point, causing the open stump to present a conical cavity, the sawn bone corresponding to its apex (Figs. 395*a* and 396).

*Bi-lateral Flap Method.*—This is admirably adapted to both the middle and lower third of the thigh.

The outlines of the flaps are made in the same manner as at the leg. They are integumentary, and are dissected up from the muscles two inches, or about half their length. The muscles divided by a circular sweep of the knife, and the bone sawn off at the same situation. The end of the bone is then seized by strong forceps, the soft parts on its posterior surface and sides pushed up, and with a small sharp pointed knife an oval or rectangular-shaped flap of periosteum is marked out and pushed upward from the anterior surface of the bone, along with the soft parts resting upon it (Fig. 395). The base of the periosteal flap must cor-

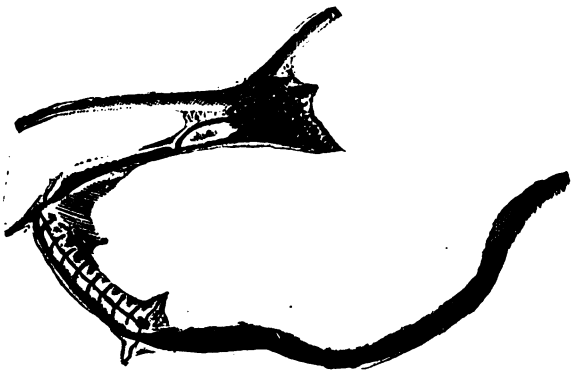

FIG. 399.

respond to the point of secondary division of the bone, which will be about two inches above the primary section. The bone is sawn again and removed. The portion of the flap having the periosteum is allowed to fall into its proper position across the end of the divided femur; the edges united, and stump dressed as desired.

*The circular* integumentary flap method can be employed upon the thigh and with admirable results. The principles governing this operation are similar to those in other situations. The division of the muscles should be at a point not less than two inches below the reflected flap, and their respective layers should be divided independently, as seen in Fig. 395*a*.

*The Single Circular Incision Method* (Celsus).—Control the

circulation, and with a long knife divide all the soft parts by a circular sweep down to the bone (Fig. 398), which is then sawn off.

The end of the divided bone is now seized by strong forceps, the surrounding soft parts drawn upward, and the oval periosteal flap made; its base corresponding to the site of secondary section of the bone (Fig. 395). Saw the bone a second time close to the anterior periosteal flap, and allow the parts to fall into apposition. They can be united transversely (Fig. 399) or the reverse; the former holds the periosteal flap in position the better.

*Long Anterior Flap Method* (Sedillot).—This can be done in any portion of the thigh. Mark out on its anterior surface a flap, the length of which should be equal to one third, and its base to two thirds of the circumference of the limb. Divide the tissues, obliquely, upward and backward, not making the flap too thick. The tissues on the posterior portion of the limb are divided transversely down to the bone, which is exposed about two inches higher and sawn off.

The rate of mortality for amputations of the lower third in gunshot injuries, is 55 per cent; at the middle third, 65 per cent; and at the upper third 78 per cent. About 13 per cent more recover with expectant treatment, in gunshot injuries, than following amputation. Primary amputation yields 21 per cent increase over the secondary. The results are considerably more favorable when done in private practice, irrespective of the cause.

## AMPUTATIONS AT THE HIP.

The causes of death from this amputation are, loss of blood, shock, and septicemia. Various plans to lessen the loss of blood have been suggested. Compression upon the abdominal aorta by the fingers, or hand introduced into the rectum by an assistant; combined with pressure by the same means upon the femoral as it crosses the pubis. In all instances, when abdominal pressure is to be applied, the bowels should be evacuated. Various forms of tourniquets have been designed for the purpose, as Pancoast's

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(Fig. 400), Esmarch's (Fig. 401), and Lister's (Fig. 403). Fig. 402 shows Esmarch's elastic tourniquet in position.

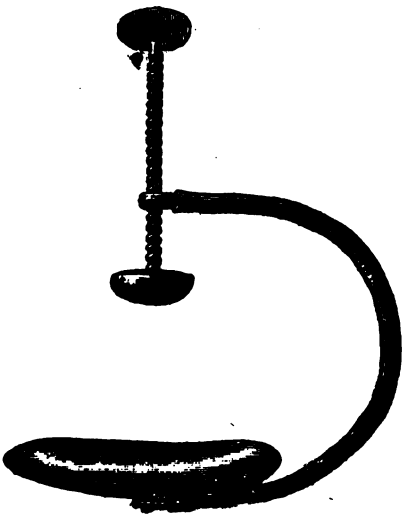

FIG. 400.

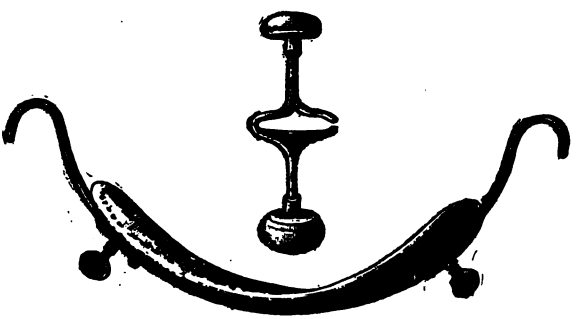

FIG. 401.

If a tourniquet be not at hand, a pad may be substituted, made by winding a linen bandage about three inches wide

and twenty-five feet in length around a stout rod or stick, one inch or so in diameter, and twelve inches long. This should be placed immediately below the umbilicus and held in position by an assistant.

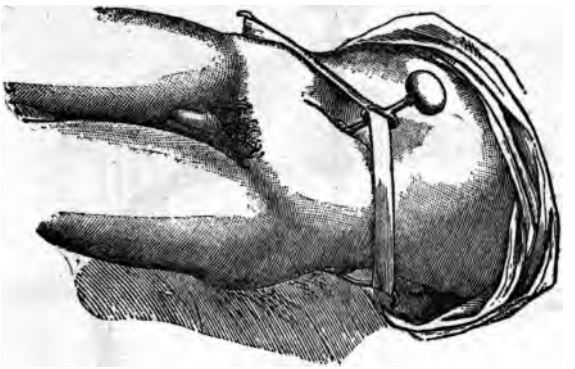

FIG. 402.

FIG. 403.

It can be confined in place, or the pressure still further increased by several turns of a rubber bandage carried over it and around the body (Fig. 404).

If the elastic traction around the body be objectionable, a longer stick can be substituted, and the compress secured in position by rubber bands around its ends and under the table (Fig. 405). Davy's lever (Fig. 38), which is described

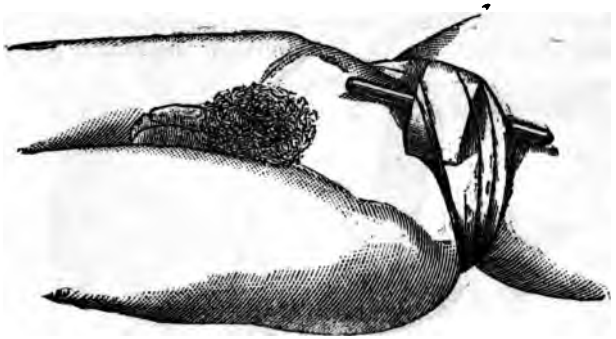

FIG. 404.

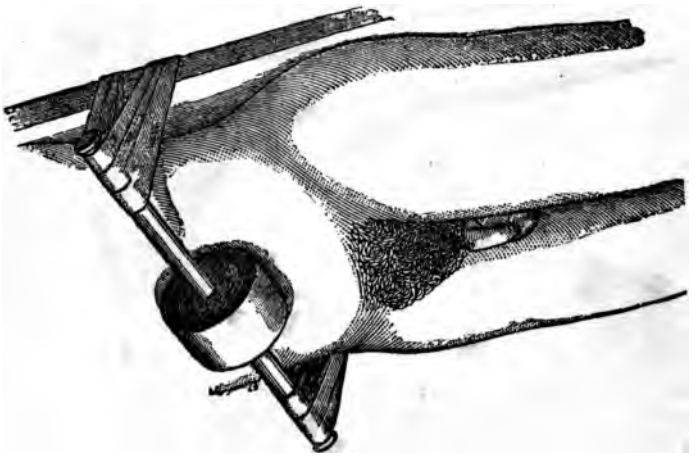

FIG. 405.

in the fore part of this book, is a useful agent to control bleeding.

It is open to the objection of being easily disturbed by the struggles of the patient, as well as the danger of injur-

ing the intestine, especially when carried to the right side of the body.

*Tredehenburg's Rod* (Fig. 39), which likewise has been hereinbefore mentioned, is of unquestionable utility. It is a steel rod between fifteen and sixteen inches long, about one fourth of an inch broad, biconvex on transverse section, and a twelfth of an inch thick at the centre, with blunt edges; but

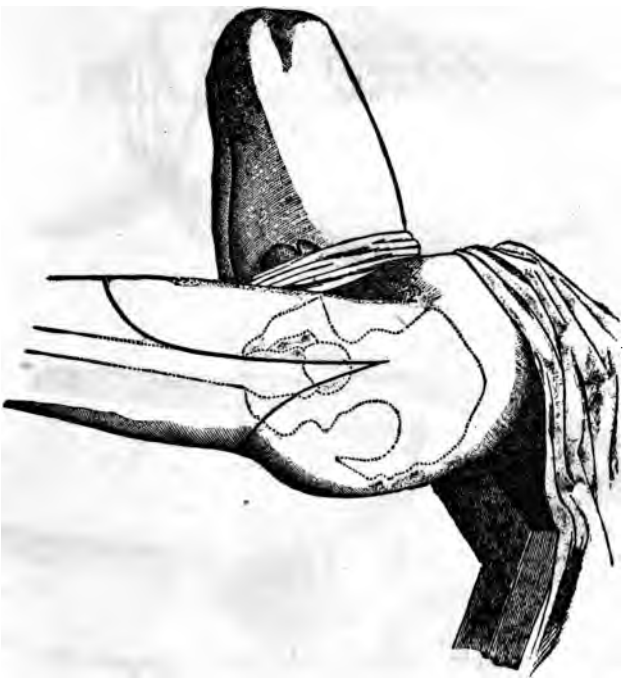

FIG. 406.

provided with a movable lance-shaped point two inches in length. The rod is passed through the soft parts in front of the joint; entering an inch and a half below the anterior superior spinous process of the ilium, passing across the femur behind the femoral artery, emerging at the posterior scroto-femoral junction. The point is removed, and a strong elastic tube or band is wound firmly, like the figure 8, around its ends, passing in front of the thigh. A long knife is then inserted in the course of the rod about

a half an inch below it, and the anterior flap made in the usual manner, and the vessels ligated. The rod is then withdrawn, the hip joint disarticulated, and the posterior flap made in a similar manner. Dr. Varick, of Jersey City, N. J., who first employed the rod in this country, did not disarticulate until he had passed it behind the neck of the femur, including as much of the soft parts on the posterior surface as possible; compression was then applied as before, and the tissues were divided by a posterior semicircular incision down to the bone. The amount of blood lost was trifling, and the patient made a speedy recovery. The rod

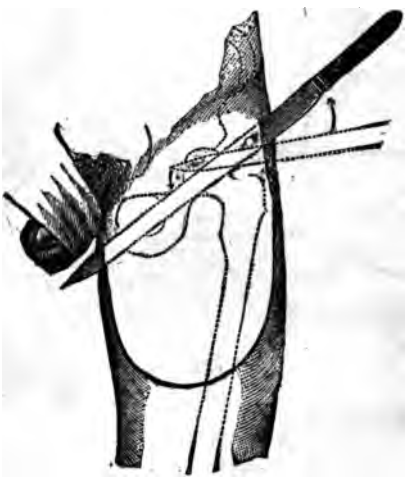

FIG. 407.

can be employed in the various forms of flaps, and therefore has an element of universality. It has not as yet been enough employed to be esteemed more than a rational expedient.

Amputation may be done by the single flap method, anterior or internal. The double flap being either lateral, or antero-posterior; the oval and the circular forms.

These general methods have been modified almost indescribably, and certainly, in many instances, impracticably.

*Amputation by a Long Anterior and Short Posterior Flap.*— Place the patient on a table so that half the pelvis, on the side to be attacked, projects beyond the edge; draw the

scrotum to the opposite side by a towel (Fig. 406). Exsanguinate the limb by the elastic bandage; after which control the hemorrhage from above by the arterial compression selected. Then remove the elastic bandage; give the limb to be removed to an assistant, and instruct another to watch the femoral as it crosses the pubes, and to catch the anterior flap and compress it before it shall have been severed from below.

The operator then enters the point of a long knife, mid-

Fig. 408.

way between the anterior superior spinous process of the ilium and the trochanter major, carrying it down to the bone parallel with Poupart's ligament; draw it back, lower the handle, at the same time the assistant flexes the limb slightly, and the point is passed through the anterior surface of the capsular ligament; the point is then turned downward and made to pass out at the inner side of the thigh, an inch or so from the perineum, and as far poste-

riorly as it can be carried easily (Fig. 407). It is then carried downward with long sawing strokes, in contact with the bone, forming an anterior flap six to eight inches in length,

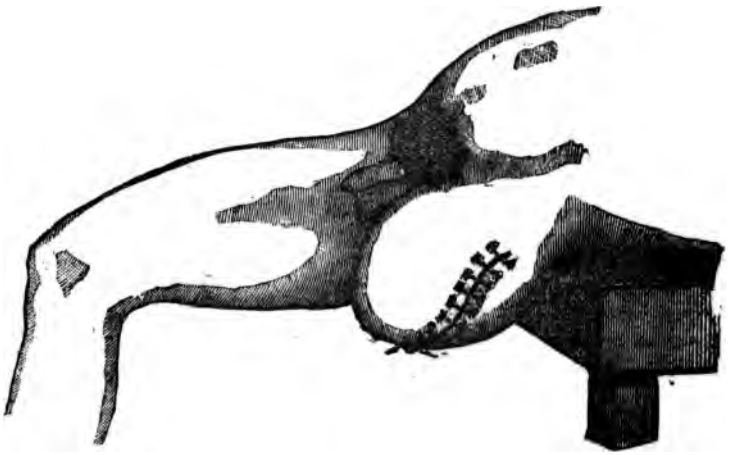

FIG. 409.

which should be caught by an assistant, who at the same time compresses the main vessel within it, and carried up-

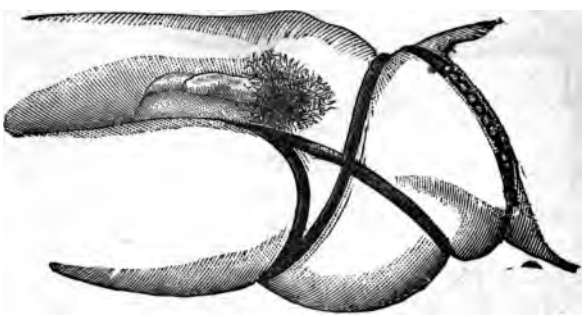

FIG. 410.

ward. The knife is then carried under the thigh to the opposite side (Fig. 408), and the extremities of the anterior incision connected by a posterior one, carried down to the bone a little below the gluteal fold, after which the bone is

disarticulated, by dividing the capsular ligament and the muscular attachments to the greater and lesser trochanters.

The joint can be quickly disarticulated after the anterior flap is made, by rotating the limb inward, and with the point of the knife quickly dividing the attachments to the trochanters, and the capsular ligament, at the same time extending, abducting, and rotating the thigh outward, to dislodge it from the acetabulum, then divide the ligamentum teres, carry the knife behind the bone, and make

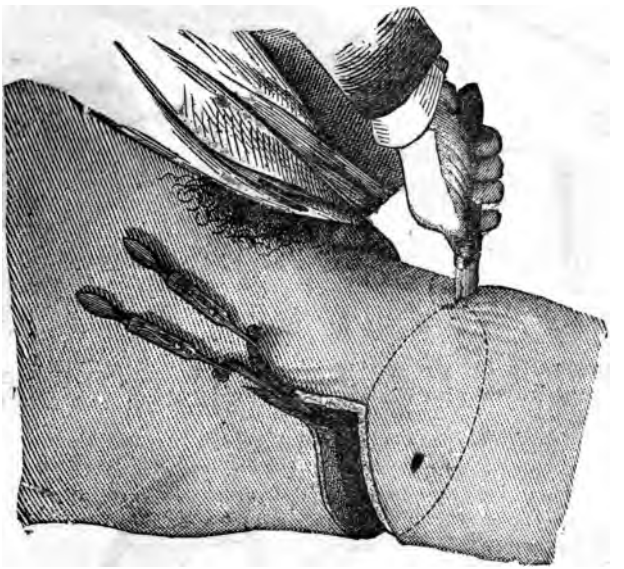

FIG. 411.

the posterior flap, cutting obliquely downward. Bring the flaps into position, and insert a long, large drainage tube into the acetabulum, allowing it to protrude at the centre of the flaps, which are then united (Fig. 409).

*Circular Method* (Diffenbach's).—Control the hemorrhage as before, or by means of the elastic ligature (Fig. 410), and with a long knife make a circular incision down to the bone, which is then sawn through. Tie all vessels, veins included. If it be impossible to employ the bloodless method, the femoral vessels should be secured by forceps,

or ligatures at Scarpa's triangle, in two situations, and the vessels be divided between them, the proximal end allowed to remain until the operation is completed (Fig. 411). Remove the elastic ligature, secure all bleeding points, and insert a knife two inches above the great trochanter, at its outer side; carry it down to the bone, over the middle of the trochanter, along the outer surface of the femur to the circular incision. Then seize the bone with a strong pair of forceps, separate the edges of the vertical incision,

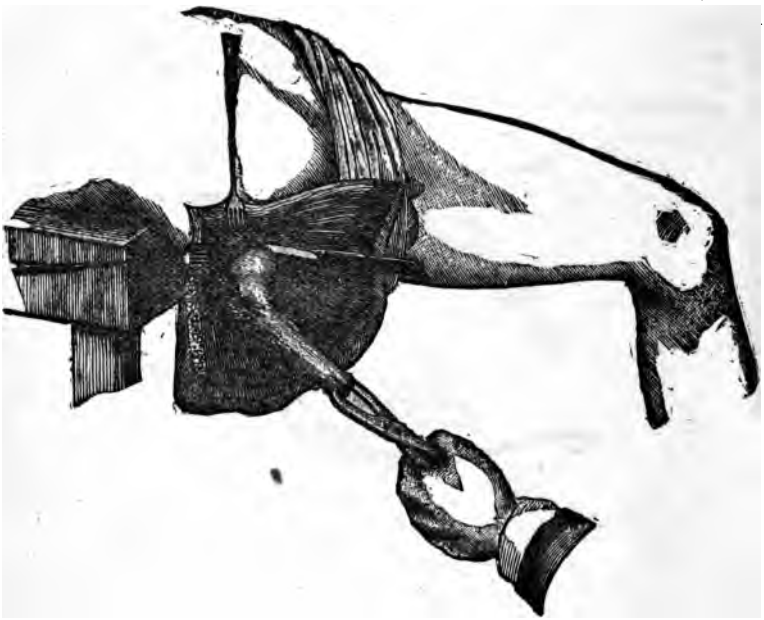

FIG. 412.

and remove the periosteum with a suitable instrument down to the points of muscular insertion, which must be separated with a knife with the edge directed towards the bone. Remove the periosteum in this manner up to the capsule (Fig. 412), which is opened and the head dislocated as before. The last step of the operation is attended with but slight loss of blood. Fig. 413 shows the appearance of the parts after coaptation. An additional drainage tube should be inserted at the lower extremity of the wound.

If the muscles are large, the flaps can be variously modified by employing either the ordinary circular or the long anterior flap, with a posterior circular incision below the gluteal fold.

If there be a deficiency of tissue on the anterior surface, the long posterior flap can be made with a transverse incision below Poupart's ligament, remembering to pass a large drainage tube in the centre of the retreating extremities of the divided psoas and iliacus tendons.

*Single Flap Method* (Malgaigne).—This admits of rapid execution, and would be, were it not for the available anæsthetic, the proper operation to select, in view of the additional shock caused by the more methodical procedure advocated elsewhere.

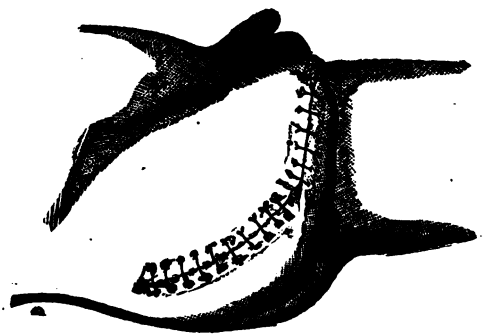

FIG. 413.

Having controlled the circulation, place the patient on the table, with the hip overhanging the edge. The surgeon standing at the outer side of the limb, which is slightly flexed and separated from its fellow, introduces the point of a long knife midway between the anterior superior spinous process of the ilium and the top of the trochanter major, directing it in the course of Poupart's ligament, down to the bone, from which it should be carefully withdrawn, and the handle depressed sufficiently to admit of the easy passage of its point across the neck of the femur, and through the anterior portion of the capsule.

If the handle be depressed before the point is raised, the point may be broken. The handle is then raised and

pushed onward until the point emerges an inch below and in front of the tuberosity of the ischium.

The flap is then made by carrying the blade downward, along the anterior surface of the bone, parallel with its line of entrance, six or eight inches, when it is brought directly to the surface (Fig. 414). Before the vessels are divided an assistant should seize the flaps, by inserting the hands into the incision, above the knife, compress the vessels, and, when severed, carry it upward on the abdomen at the same time the surgeon divides the remaining anterior portion of the capsule with the point of the knife; the assistant rotates the thigh inward, that he may sever the attachments to

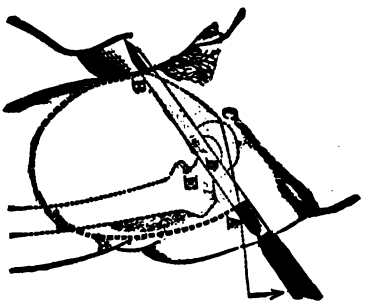

FIG. 414.

the great trochanter, then quickly rotates it outward and abducts it, causing the head of the bone to escape sufficiently to expose the ligamentum teres, which the surgeon divides with the point of the knife, and as the head slips from its cavity, he passes the blade behind it, seizes the head with the left hand and quickly severs the posterior tissues by an incision directed downward and a little forward.

The *lateral flap* method offers no advantages over the antero-posterior, other, perhaps, than easier drainage. This point, however important it may have been before the drainage tube of the present time, cannot now be said to be of such marked significance.

*Anterior Oval Method* (Verneuil).—Apply the elastic bandage as far up as consistent with the proposed incision. Control the aorta and make an incision through the integument

and fascia, commencing an inch below Poupart's ligament, in the course of the femoral vessels, two inches in length; continue it outward, transversely across the base of the great trochanter, to the gluteal fold, and along this to the inner side of the thigh; then obliquely upward two inches below the genito-crural fold, to the lower end of the vertical incision. Isolate the femoral artery and ligate it above and below the bifurcation of the profunda, and likewise ligate the latter a little distance from its origin. If no intervening branches exist, divide the femoral between the ligatures, isolate the femoral vein, ligature it and divide in the same manner. Carry the incision through the muscles, from whichever aspect of the limb is most convenient, seeking for and ligating all bleeding points as soon as apparent. Open the capsule in front, dividing its posterior position as closely as possible to the neck of the femur, along with the remaining tendons inserted into the head of the great trochanter. Depress the thigh, causing the wound to gape widely, and divide the muscles on its posterior surface, in the same manner as those preceding. Finally draw down the sciatic nerve, and cut it short enough to be above the border of the flap.

The tissues left are not sufficient to close the wound, which is dressed with a thin layer of tarletan in contact with the cut surface, upon which charpie saturated with some antiseptic solution is placed, and the whole covered with cotton batting surrounded by oiled silk, which is held in position by a simple bandage. The wound is kept moist with the disinfecting solution.

*Results.*—The rate of mortality is governed by the cause calling for the operation.

In immediate amputation in military practice, 93 per cent die.

In civil practice, the primary amputation reaches 80 per cent. Secondary amputations offer better results; 60 per cent recover in the civil and military combined.

The results are more favorable in non-traumatic cases, being less than 41 per cent. Taken together, the rate is a little over 64 per cent, being a trifle more than for amputation in the continuity of the thigh (63.8 per cent).

## DEFORMITIES.

Deformities may be either congenital or acquired, and in either case they can be referred to the soft or hard parts, either severally or conjointly.

The acquired deformities calling for operations in a special sense depend on anchylosis of joints, distorted shafts and extremities of bones, irregular or unequal muscular contraction, and the congenital fusion of parts. To overcome the deformities dependent upon anchylosis, we have forcible movement, if it be fibrous; and the division of the bone, or joint structure, if it be bony.

The forcible breaking of an anchylosed joint, while not an operation in the accepted sense of the term, is nevertheless often associated with consequent amputations, which entitles it to a greater degree of prominence than many accepted operative procedures.

*Brisement forcé*, as it is sometimes called, should be preceded by subcutaneous section of all the tendons, muscles, and fascia upon which point pressure causes reflex action.

The incisions having healed, place the patient upon a hard table, give an anæsthetic, and while the portion of the limb between the joint and the body of the patient is held firmly by assistants, the surgeon seizes the distal portion and forcibly flexes it, employing steady and persistent force. As soon as moderate movement follows flexion, it is then forcibly extended, and by repeated flexion and extension the range of motion of the joint is re-established.

If the knee be the one in question, the patella should be loosened before it is attempted. After the operation strap the toes and bandage the limb from the toes to the knee firmly, having first applied plaster for the purpose of extension. Pad the popliteal space with cotton, and shingle the knee with strips of adhesive plaster. Continue the roller over the knee and up the thigh, applying pressure to the femoral by means of a small piece of wet sponge, applied over its course and held in position by the ascending bandage.

Place the patient in bed, apply extension, with the foot of the bed elevated, also ice bags to the knee, the limb being immovably confined. At the end of five or six days

the dressings are opened and slight motion made; again replaced, with omission of the sponge.

*If the anchylosis be bony*, the deformity can be relieved by osteotomy above the condyles, and if necessary below the head of the tibia at the same time, or by excision of the joint, or the removal of a triangular piece above, it having the same angle as that formed by the junction of the tibia and femur in the popliteal space. The same principle can be applied above the knee as applied by Barton (Fig. 415).

Boring the joint and other expedients have been resorted to. The most satisfactory of all, however, is osteotomy above the condyles, which is described under that heading.

FIG. 415.

In all joints, anchylosis is amenable to the same procedures heretofore stated.

Deformities caused by distortion of the long bones, can be best corrected by osteotomy, associated with the antiseptic dressing.

*Curvature of the Spine.*—A popular method of treatment at this time is the application of the plaster-of-Paris dressing. The body of the patient should first be surrounded by a closely-fitting knit jacket, between which and the region of the stomach is introduced a wedged-shaped "dinner pad," with the point downward; composed of several thicknesses of cloth, or cotton wadding surrounding it. All sensitive parts and projecting points should be relieved from direct pressure by spongio-piline, cotton, or other similar material. The same can be placed over the iliac spines and the adjoining portions of the crest.

"The mammary glands in the female should be protected, and suitable space be provided by the introduction of proper shaped pads.

"Tie the shirt over the shoulders and fasten it between the legs. Then the patient is drawn up gently and slowly until he feels perfectly comfortable, *and never beyond that point.* A prepared, saturated roller having been gently squeezed, so that all surplus water is removed, is now applied around the smallest part of the body, and is carried

round and round the trunk downward to the crest of the ilium and a little beyond it; afterward in a spiral direction from below upward, until the entire trunk from the pelvis to the axillæ has been encased.

"The bandage should be placed smoothly round the body, and must not be drawn tight; it should be simply unrolled with one hand while the other follows and brings it into smooth close contact with all irregularities of the trunk.

"After one or two thicknesses of bandage have been placed around the body in the manner described, narrow strips of roughened tin can be placed parallel with each other on either side of the spine, if the case requires it, with intervals of two or three inches, and in number sufficient to surround the body. Over these another plaster bandage is applied. In a very short time the plaster sets with sufficient firmness, so that the patient can be removed from the suspending apparatus and laid upon his face or back on a hair mattress, or, what is preferrible, especially when there is much projection of the spinous processes or sternum, an air bed. Before the plaster has completely set the "dinner pad" is removed, and the plaster gently pressed in with the hand, in front of each anterior iliac spinous process, for the purpose of moulding the case over the bony projections.

"While the jacket is drying it is necessary, sometimes, to wet it with a little water and dust it with more plaster. The surgeon often leaves some weak spots that need strengthening in this manner." The preceding is a description as recorded by Dr. Sayre, to whom the profession is indebted for the prominence which has been given this method.

The *deformities dependent upon perverse muscular action* are, in an operative sense, relieved by subcutaneous division, called myotomy and tenotomy, which has been before considered.

*Deformities due to fusion* of the parts and supernumerary attachments, like webbed fingers and toes, and supernumerary digits, although not common, are, nevertheless, entitled to some consideration.

The operative treatment for webbed fingers will depend very much upon the extent as well as the thickness of the attachments; whether the connections be limited to the soft parts alone, or the bones be fused. Digits which are united by their extremities only can easily be separated by

the division of the tissues which connect them. If they be united their entire length, even then an incision in the median line of their attachments, down to the line of the normal web, may be sufficient to effect a cure, if the tissues connecting them be not too thick; if such be the case, great difficulty is often experienced in healing the divided surfaces, owing to the tendency to reunion at their point of junction. To obviate this various expedients have been recommended, one of which is to introduce a rubber seton at the base of the malformation, on a line with the normal web of the hand, and allow it to remain until the opening becomes permanent (Fig. 416), when the remaining portion

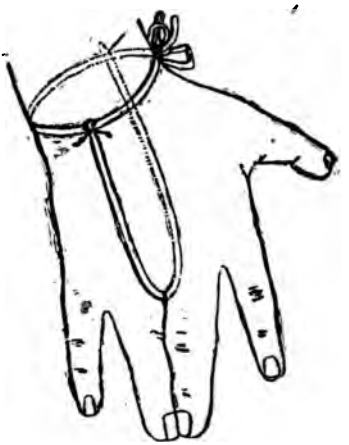

FIG. 416.

is divided and the borders united by sutures. Another plan is to make a triangular flap from the posterior portion of the web, the base to remain attached, and correspond in shape and size to the space between the knuckles.

Its apex is of course directed to the free edge of the abnormal attachment. The flap having been raised the remaining portion of the attachment between the fingers is divided, and the triangular flap adjusted to the base of the cleft, kept in position until union takes place. The remaining borders of the wound are united by sutures the same as before.

It has been suggested to make two such flaps, one on the palmar and one on the dorsal aspect, at the same situation; cut off their extremities and unite them at the cleft, when the remaining portion can be divided longitudinally.

Another, a very effectual and ingenious method, is best described by M. Nélaton, its designer: "A longitudinal incision is made in the centre of the phalanx of one finger on the dorsal aspect, for the posterior flap; on the palmar aspect of the other for the dorsal flap, the length of the incision will correspond with the depth of the web. From either extremity of the longitudinal incision, a small transverse one is to be made towards the phalanx of the connected finger (Fig 417, B). The lower transverse incision will correspond to the free edges of the web; the upper one will cross the cleft between the fingers. Each flap is now to be dissected back towards the contiguous fingers. In doing this the two folds of the web will be separated from each other, one entering into the formation of the posterior flap, the other into the formation of the anterior. Each flap will now be found to be attached by one edge only, and is to be wrapped around the denuded surface of the finger to which it is attached. The flaps are to be adjusted by strips of adhesive plaster, and by sutures."

FIG. 417.

Annandale suggests that, "The principal objection to this ingenious operation appears to me to be that it necessitates cutting into the palmar and dorsal aspects of the fingers in order to get a flap to cover their sides." If the web or fold of the skin were loose, he deems it preferable "to make the longitudinal incision along the sides of each finger instead of along the centre of the dorsal and palmar aspects." Triangular flaps may be made at the base of the web, and the remainder cut directly through (Fig. 417, A). If the former be done (B), care must be taken in uniting the flap, else sloughing will follow. When the bones of the digits are fused, it is not wise, as a rule, to attempt their separation, since, though it be accomplished, the remaining digit may have its function greatly impaired. If a supernumerary digit possess an in-

dependent articulation, it can be removed without any great danger to its associate.

*Ingrowing Toe-nails.*—This is quite a common affliction, to the relief of which various palliative measures have been directed. As a rule, however, they have been found inadequate to effect a cure. This condition is largely induced by improperly fitting boots and shoes, although in some persons there exists additional predisposing causes. Going barefooted would in a majority of cases perform a speedy cure, but since the customs of the country as well

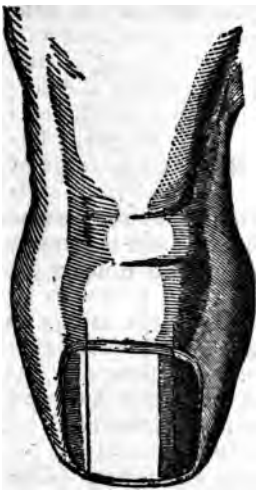

FIG. 418.

FIG. 419.

as the pride of the afflicted interdict this, operative measures are often necessary. When the affection is fully established, administer an anæsthetic, and with a sharp-pointed scalpel divide the nail its whole length on a line with its ingrowing portion (Fig. 418), which portion can then be quickly and easily removed by a thin bladed pair of forceps, or a narrow spatula passed beneath it. If the other side be affected, it too should be removed in the same manner. Cauterize the exposed matrix and apply a hot anodyne poultice at once. The patient should keep quiet until the tenderness has in a measure subsided. It

no instance should the entire nail be removed, unless it be diseased.

*Bunions.*—This affliction is accompanied in a large proportion of cases by malposition of the great toe (Fig. 419), and an increase in the normal size of the bursa, or the development of an adventitious one. The operative means for relief consist either in the excision of the bursa, or its subcutaneous division into numerous fragments by means of a narrow tenatome. If these means fail, excision of a sufficient amount of the metatarsal bone to admit of the toe being returned to its normal position should be done, after which it is confined in place until recovery is established.

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## PLASTIC SURGERY.

This form of operative surgery relates to the various means adapted to overcome or alleviate the deformities of aspect and function resulting from congenital defects, disease, and accidents.

Inasmuch as the successful issue of these operations has far more to do with careful attention to the details and small matters connected with them than anything else, it is well for the operator to understand at once that there is no precaution too trifling to be treated with indifference.

*Preparation of the Patient.*—The patient should be in a vigorous physical condition, his appetite and functions normal, and the surroundings of such a character as to combine quietude of mind with close and gentle attention. No association can be allowed with putrefactive processes, or diseases known to engender changes derogatory to union and repair. Prior to the operation the part should be purified by a solution of carbolic acid or other suitable agent.

*Size of the Flap.*—The shape and size of the flap should be ascertained by careful measurement. A pattern of the deformity to be repaired should be carefully cut out and used to outline the tissues to be employed in filling the gap, since the contractile power of the normal tissues when loosened from their continuous attachments, causes enough shrinkage to require undue force to maintain proper coap-

tation of the borders, the reparative flaps must always be made large enough to admit of a few lines shrinkage to each inch of surface.

In choosing the material to form the flap, it is necessary that it consist of sound, healthy skin; and, under no consideration can cicatrical tissues possessed of a pale, glossy surface be employed; for, when its underlying connections are severed it is almost certain to slough, especially when the result of a burn. The relation which cicatricial tissue bears to a flap is all important. If it exists at its base, sloughing is quite certain. Cicatricial tissue at the border of a flap is quite certain to die, and its presence must not be estimated in computing the area of the new flap. When the new flap is to be surrounded on three sides by cicatricial formations, its base must be large, vascular, and but little twisted; as the medium of supply at its sides will be very much lessened by its new association. The long axis of the flap should correspond to the course of the vessels from which it derives its nourishment, and its base should be lo-

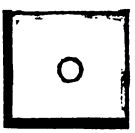


FIG. 420.

cated as nearly as possible to the nutritious vessels. All hemorrhage must be checked before the flaps are united, since it not infrequently happens that a thin clot of blood prevents union. The direction of the flap should be such that it can be placed with the least twisting of the pedicle. The silver wire and carbolized silk or horse-hair make efficient sutures, which should not be drawn tightly. To avoid the danger of ulceration at the pressure points, small squares of carbolized, bibulous, or unglazed paper, having a diameter of half an inch or less (Fig. 420), with small holes through the centre, or punctured through the centre by the pin or needle carrier at the time of carrying the ligature, can be used to tie them upon. The edges of flaps should be bevelled at the expense of the external surface; this increases the width of the opposed surfaces, and when combined with undercutting of the other borders, increases the chances of union. A small slip of the bibulous paper can be placed between the sutures and the edges of

the wound at the point of crossing. The use of carbolized cotton yarn, which should be frequently changed, in connection with the plastic pins, offers a soft and otherwise admirable retaining agent.

## METHODS OF TRANSFER.

The methods of transfer may be classified into six general forms, with their subdivisions. Tissues may be transferred: 1. By sliding in a direct line; 2. sliding in a curved line; 3. by jumping; 4. inversion, or eversion; 5. the Taliacotian; 6. grafting.

*Sliding in a Direct Line.*—The simplest form of this method consists in uniting the lips of an ordinary incision, and is sometimes called "simple approximation of divided surfaces."

*The second variety* is called "undercutting," and consists

FIG. 421

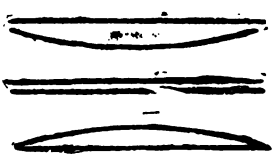


FIG. 422.

in cutting under the edges of the incision on each side, and drawing them together.

*The third variety* is sliding in a direct line, by aid of parallel incisions on both sides of the primary one, which is closed; and the outside ones heal by granulation (Figs. 421 and 422). Cutting under in this method lessens the separation of the parallel lines.

*In the fourth method* the incisions are made tranversely, that is, at right angles with the extremities of the cut, and undercutting is employed to (Figs. 423 and 424) allow this opening to be closed. The uppermost curve is undercut, and the other is a combination of undercutting and sliding by the aid of transverse incisions. If this method be applied to those parts which cannot resist retraction, a second deformity is liable to follow.

*Sliding in a Curved Line.*—This can be done with flaps having either curved or angular borders. In the former instance the space from which the flap is taken is filled by under-cutting its borders and drawing them together. In the latter the space is usually allowed to granulate.

*Jumping.*—As the name implies, consists in "jumping a

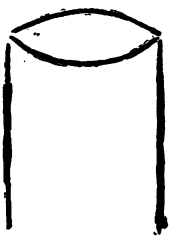


FIG. 423.

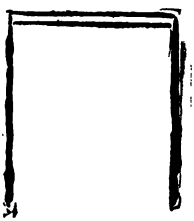


FIG. 424.

flap connected by a pedicle over intervening undetached tissues." It can be done with or without the pedicle being twisted.

If the flap be not moved more than a quarter of a circle, twisting is not necessary. Undercutting is employed in this instance when necessary to adapt the parts properly.

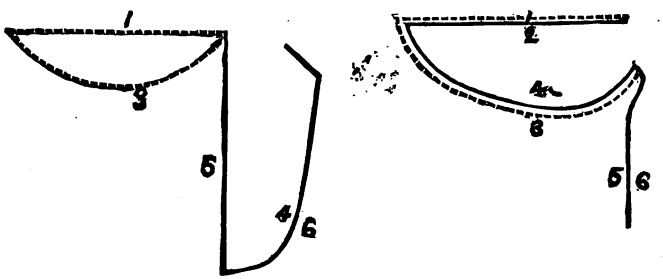



FIG. 425.

The plan without twisting the pedicle is shown in Fig. 425. When the flap is moved more than a quarter of a circle the pedicle will be twisted, the degree of course depending on the distance the flap is moved.

If the pedicle be too much twisted, the circulation will be impeded and sloughing ensue.

*Inversion or Eversion.*—These relate simply to the employment of integument in repairing a mucous membrane, or vice versa. Tubular formations may be constructed by either of these tissues, as in the formation of new canals, like the urethra, vagina, and closure of an extroverted bladder.

*The Taliacotian Operation.*—This is familiarly known as dissecting a flap from another and distant portion of the body, allowing it to granulate, and applying it to the part in question; as in the familiar representation of the construction of a new nose.

*Grafting*—is but little employed. It is done by the entire removal of a flap from one place to another.

## RHINOPLASTY.

Rhinoplasty consists in reproducing a part or whole of the nasal organ. The present greater ability to arrest the conditions causing these deformities has lessened the frequency of this operation. Ingenious contrivances of ivory, rubber, etc., have been made to fit them and supply the lost parts. These, when tinted to conform to the complexion of the wearer, often prove quite deceptive; but being unaffected by the various contingencies of the weather and emotions, they often present a ludicrous appearance. Save all that is possible of the cartilaginous and bony tissue, for they afford important support. The cartilages of the alæ should, when possible, constitute the free border of the new structure.

The deformities of this organ may be due to: 1, a loss of the superficial soft parts, which may vary in extent and degree; 2, of the bony or cartilaginous septum, with or without loss of the nasal bones; 3, or both combined. The soft parts may be restored by either of the first five methods named. The extent of the deformity and its situation will govern the choice. When the loss of the integument is small and does not involve the alæ and the deeper structures, the deformity may be remedied by the direct approximation of its borders, aided, of course, by a free undercutting with or without parallel incisions. The French

method, by transverse incisions, combined with undercutting, can be done (Fig. 426) when the former is deemed inadequate. If the extremity or an ala be involved, the second method, or "sliding in a curved line," the flap having either curved or angular borders. Fig. 427 represents the restoration of the ala by a flap taken from the cheek. The reader will notice the excess in size of the flap over the defect it is to be applied. It must be of sufficient size to allow at least one fourth for contraction, otherwise when united it will displace the axis of the nose, thereby substituting one deformity for another. Langenbeck repaired

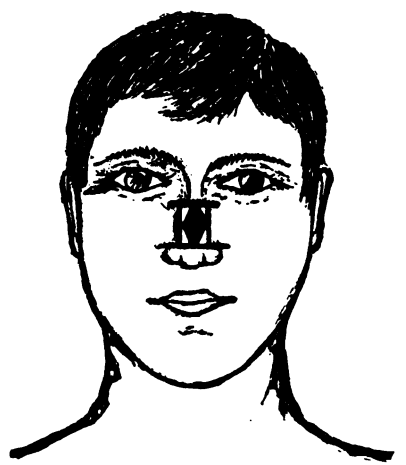


FIG. 426.

a similar deformity by taking a flap from the opposite side of the nose. As in the preceding method, the dissection must be carefully done down to the cartilaginous framework. The border of the new ala, although freshly cut, heals in a satisfactory manner. Fig. 428 demonstrates the line of incision employed to repair the loss with a flap possessing an already cicatrized border. The vascular supply of this flap is the least active, and every precaution should, therefore, be taken to provide against the danger of sloughing. If either ala be absent, and the resulting

gap be a large one, the material for its repair can be taken from the forehead, as shown in Figs. 429 and 430. It will be seen that the pedicles are admirably located to receive ample nourishment.

If the columna be absent, it may be replaced by structures taken from the upper lip. It is better to include the whole thickness of it, tipping it upward directly into place,

FIG. 427.

than to make an integumentary flap, the adjusting of which will require a smart twisting of the pedicle. In the former instance the cuticle is dissected off and the raw surface carried into position. The mucous surface soon assumes integumentary characteristics. If the lip be deficient at the point of selection, a flap can be taken from beneath either ala and carried into place.

*Loss of the Bony or Cartilaginous Septum, with or without*

*Loss of the Nasal Bones.*—The loss of the cartilaginous portion of the septum, with the remaining tissues intact, causes a flattening of the end of the nose, or a hollow at the lower end of the nasal bones. Sliding of the tissues may temporarily relieve the deformity; but traction of the flap and miscellaneous interferences from without soon reproduce it. Mechanical ingenuity bids fair to afford more

FIG. 498.

relief than surgical, especially if it be associated with an opening through the hard palate. If the nasal bones remain intact, the loss of the bony septum is not manifested by any external deviation. If the septum and nasal bones be gone, it then becomes necessary, in order to relieve the deformity, to elevate and maintain in that position the tissues composing the soft parts of the nose. To accomplish this

requires an internal support of some sort, although much may be gained by dissecting up the soft parts on each side of the nose, and raising them in the line of the bridge by approximating their base by means of pins passed through it and confined in position until union is accomplished. In 1829 Diffenbach published a manner of performing an operation by which he overcame the deformity resulting from the loss of the nasal bones and the septum. An incision was made with a narrow-bladed knife along the

FIG. 429

outer side of the sunken border of each nostril, the intervening strip being three times broader at its connections with the upper lip than above where it joined the forehead. On either side of these incisions another was made down to the bone, beginning a few lines below, and to the outer side, and carried obliquely downward, parallel with the primary one, and external to the side of the nose, around into the nostril, thereby separating the alæ. The columna was elongated by the short parallel incisions in the upper lip, cheeks dissected up from their bony attachments,

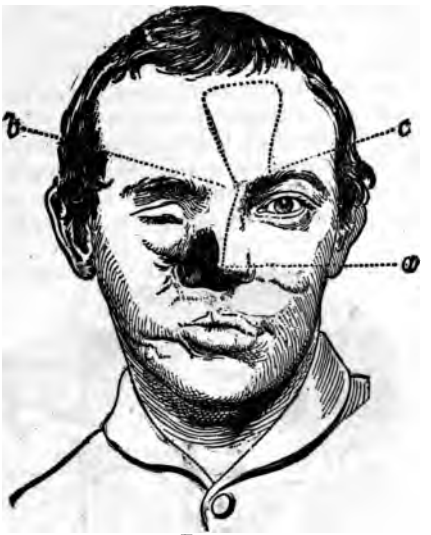



FIG. 430.

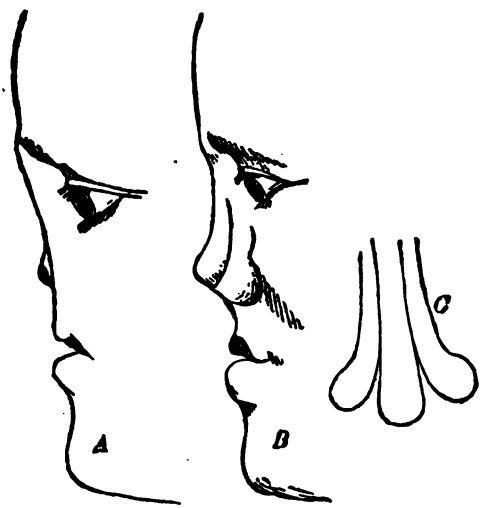



FIG. 431.

through the lateral cuts, sufficiently to render them freely movable. Their flaps were then raised, their borders pared obliquely, reunited and joined with pins and sutures, and retained in position by drawing the detached cheeks towards the median line, where they were retained by two long pins passed through their borders, under the nose. In this instance the pins were passed through two narrow strips of leather, which equalized the force and obviated the premature ulceration by the pins. A quill surrounded by oiled lint was then introduced into each nostril. The accompanying figure illustrates the proceeding, with its result (Fig. 431).

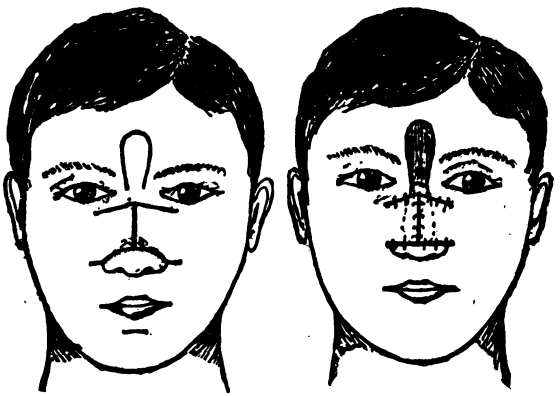


FIG. 432.

*Superimposed superficial flaps* were successfully employed by Verneuil. In this instance the alæ and tip of the nose were uninjured, yet flattened by loss of the support of the septum. He made a longitudinal incision along the median line of the nose at the centre of the depression, and a transverse one extending from each end of the first to just beyond the contour of the nose (Fig. 432), also dissecting the flaps freely from their attachments. An oblong flap of suitable size was then raised from the forehead, its pedicle located directly between the eyes; this was turned downward, bringing the raw surface uppermost. The lateral flaps were then drawn inward upon it and united in the median line.

*The Indian Method* (Fig. 433).—This at one time was the prevailing method. Where the septum and a large proportion of the soft parts were absent, and even when the lower extremities of the nasal bones had sustained a loss, the tendency to atrophy and sliding down of the flap after union had taken place, accompanied by closure of the nostrils and greater danger to the life of the patient, caused it to

FIG. 433.

be substituted by more satisfactory measures. A flap was made of the shape, but of one fourth larger size than the gap to be filled; its base was a half an inch broad, and located between the eyebrows, and was substantially of the shape of the ace of spades; the stem above being intended to form the columna, and included all the tissues down to the periosteum. The edges of the gap were freshened, and the flap twisted on its pedicle and attached to its margin

with the raw surface undermost. The flap was made prominent by the aid of greased plugs introduced into the nostrils, likewise by drawing the cheeks towards the median line by the means of pins passed through them beneath the nose. The tendency to slide downward has been combated by various methods—such as connecting the pedicle with a longitudinal incision at the side of the nose; the attachment of the whole length to a newly formed raw surface at its base, grafting the sharpened pedicle into the integument at its base.

FIG. 434.

*Italian Method.* — This old method has many virtues, and were it not for the great difficulty in keeping the parts in position, would be much more employed. The flap is taken from over the biceps, with its apex towards the shoulder. It is first dissected up, and its extremities allowed to remain attached, until suppuration is established, when the proximal end is separated and the dressing continued until it is well shrunken and the under surface cicatrized. It is then applied to the gap after the edges have been freshened (Fig. 434). When union is completed, the pedicle is cut, and the flap shaped to best relieve the deformity.

*Osteoplastic Rhinoplasty.*—The periosteum has been removed from a part of the frontal bone, in connection with the flap, and consigned to the gap, hoping that the formation of new bone might occur, which would give solidity as well as prominence to the new nose. The removal of the periosteum from the frontal bone is not devoid of danger by any means. Osteo-myelitis has arisen therefrom, followed by pyæmia and death. The periosteum can form a portion of the flap, first applied in the double-flap method, shown by Fig. 432. It is true that the relation of its surfaces will be reversed, but this cannot change its bone-pro-

ducing value; moreover, if bone be formed, it can be easily moulded to suit the proposed outline of the organ.

An operation was performed sometime since by Ollier, for a deformity caused by the loss of the alæ, columna cartilages, lobe, and a portion of the septum due to lupus. The nose was not more than an inch long, due to arrest of development of the ossa nasi, to which was attached a strip of cartilage. The integument of the lip and cheeks had

FIG. 435.

been involved, and could not therefore be depended upon for flaps.

He commenced two diverging incisions in the median line of the forehead two inches above the eyebrows, and carried them downward to a fourth of an inch from the outer side of the nasal orifice (Fig. 435). The upper portion of the triangular flap included the corresponding portion of periosteum down to the upper end of the nasal bones. The dissection was continued along the right nasal bone, omitting the periosteum, down to its lower end, from

which the cartilage was separated, but it remained attached to the flap. The left nasal bone was separated from its bony connections with a chisel, leaving it attached to the flap by its anterior surface; the cartilaginous septum was then divided from before backward and downward with scissors, and left attached by its base to the cutaneous cartilage, that its central support might be provided for the new structure, resting upon the remains of the septum. The whole flap was then drawn downward, until the upper border of the loosened nasal bone (left) came opposite to the lower border of the right one, when they were fastened together with a metallic suture. The sides of the flap were then united to the cheek and the frontal incision closed above its apex.

In this instance, the space left by the removal of the left nasal bone was filled by bone provided from the periosteum, slid down from the forehead.

The deformity has been relieved by attaching a finger to the sides of the chasm. The nail was first removed and the palmar surface denuded by means of lateral flaps down to the distal third of the first phalanx. The finger was then fastened into position upon the freshened borders of the deformity, by means of the lateral flaps, and when union was sufficient to sustain the part, the finger was amputated at the junction of the middle and distal thirds of the third surgical phalanx, and the end turned downward to form the end of the nose and its columna.

The detail essential to the proper description of this operation, which was lately done with success by Dr. T. T. Sabine, is too extensive to be considered here. A full account of this very interesting case can be found in the April number of the "Illustrated Quarterly of Medicine and Surgery," 1882.

*Subcutaneous Method.*—This consists in the subcutaneous division of the depressed tissues, by which they are separated from their bony connections. This was done by Prof. Pancoast in 1842, and can be best described in his own language.

"A long, narrow-bladed tenotomy knife was introduced on either side by a puncture through the skin over the edge of the nasal process of the upper maxillary bone. The knife was pushed up under the skin to the top of the nasal cavity, and then brought down, shaving the inner side of the bony wall, so as to detach the adherent and inverted

nose upon either side. The point of the nose could now be brought out. The nose still remained adherent to the top of the nasal chasm. The knife was a third time introduced under the skin, in a direction corresponding nearly to the long diameter of the orbit of the eyes, and the adhesions separated from the nasal spine and the internal angular processes of the os frontis. The soft parts and the cheeks were loosened, by sweeping the knife outward along the surface of the bone, so far as to divide the infra-orbital nerve and artery on each side, down towards the median line, and held together with sutures passed through the cavity of the nose."

As before noted, mechanical appliances can be employed

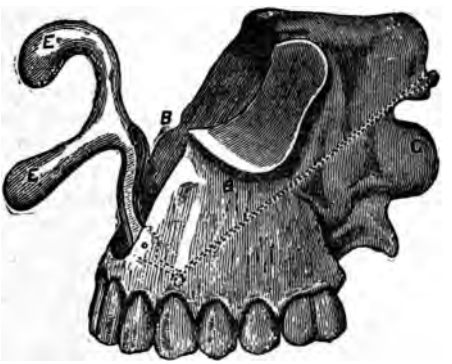



FIG. 436.

to support the soft parts, provided an opening exist through the roof of the mouth. Fig. 436 shows the lever employed to support the part in position.

In this instance, however, it is attached to an apparatus intended to relieve an additional deformity. "The processes E E pass into the nose, and support the sunken portion. The nasal elevator must be so arranged as to fall back of the line B B, to be introduced, and then must extend into its position. This is accomplished by attaching the elevator to the denture by a joint, as seen in the engraving, and also by extending an arm of the elevator within the shell, and terminating it with a hook." The dotted lines show the lower end of the lever and the elastic attachment which retains it in position. The irritation

consequent of the pressure of the lever is not severe, and can be lessened by covering the ends with lint, cerate, etc.

The degree of elastic tension can be regulated at the will of the patient, and even be entirely removed during the night.

## HARE LIP.

This deformity constitutes a large proportion of the congenital defects calling for operations upon the face.

It can be done at any age, but the best time is as soon after birth as the infant becomes well educated to take its food and enabled to bear the loss of blood. If the infant be plump and robust, it can be done easier than if weak and puny. The exceptions are rare when it cannot be done at three months of age. It is important to have complete control of the patient during the operation. For this purpose, an anæsthetic should always be given, chloroform being usually selected. The arms should be placed at the sides, and the whole body surrounded by a napkin, pinned sufficiently tight to prevent their withdrawal.

An assistant takes the child in his lap, while a second stands behind and holds its body, the head being firmly held between the hands of the first. This will enable him not only to control the movements of the head, but likewise the facial and coronary arteries, or to bend the head forwards, that blood may escape from the mouth. He can also keep up the anæsthetic with a small sponge held between the index fingers. The success of the operation will depend in a very large degree upon the entire absence of tension when the parts are placed in position. To accomplish this, it is often necessary to separate the lip and cheeks to a considerable extent from their bony connections. In some instances, owing to the difficulties of the case, the loss of blood will be considerable, unless every precaution be taken. The coronary vessels usually supply the bleeding points; they can be controlled by grasping the lip at either side of the incision, between the thumb and finger. In this manner, the same force that puts the parts upon the stretch, checks the flow of blood. The fingers of the assistant are often in the way, especially if the cleft be a large one.

Their use can readily be supplemented by passing through the lip, at each side of the proposed cut, a strong silk ligature, which when tied in a loop, will enable the parts to be

FIG. 437.

kept on the stretch without any inconvenience. The ligature can be so passed that when the parts are put upon the stretch the coronary vessels will be compressed.

Milne's artery compression forceps, one on either side, will control the hemorrhage admirably. If the blades of the ordinary dressing forceps be surrounded by adhesive plaster and closed by rubber bands passed around them, a useful substitute will be had for the ones just mentioned. The additional instruments needed are a strong pair of scissors, two scalpels—one sharp pointed, and Butcher's bone pliers (Fig. 437), if the case be complicated with a projecting intermaxillary bone. A liberal supply of hare-lip pins, Buck's needle carrier, silver sutures, and the needles and needle-holder. The variety of suture and the degree of tension has been already considered under the heading devoted to that purpose. The paring of the borders can be done with a sharp pointed scalpel, strong scissors, or the triangular cataract knife; the latter is a very useful instrument for this purpose. It is not admis-

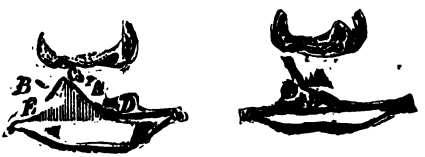



FIG. 438.

sible to sacrifice the parings taken from the free borders of the cleft, except in cases with but little deformity; they should remain attached and be utilized in filling in the gap, it being the only satisfactory means of avoiding the occurrence of the objectionable notch; often seen at the free border of the lip. The points of perforation of the pins should be at least a third or fourth of an inch from the borders of the wound, and even further, if there be any degree of tension. One or two will be sufficient in the majority of cases. Neither pins nor sutures should be passed through the flaps, but nearly to their under surface. The sutures can be inserted nearer the edge of the wound and of a sufficient number to properly connect its lips. The latter should be removed within two or three days; the former may remain longer. If ulceration begins around the pins they should be removed after others have been inserted at fresh points to receive the strain.

*Simple Hare-lip, Single.*—This can be treated by variously directed incisions; the simplest being to refresh the borders

of the cleft, loosen the labial connections to the bones and bring the edges directly into contact, being sure to secure an accurate coaptation of their vermillion borders. This is often followed by a notch at the border of the lip where the flaps are joined.

*Single Flap.*—Draw down both portions and freely sever their connections with the bone; pare the border of the longer portion and make the flap on the shorter; approximate and unite them, as before described (Fig. 438).

*Double Flaps.*—Pass a silk ligature through each angle of the fissure, as described before; divide the sublabial connections; make one side tense and transfix near the border of the lip, and cut upward to the apex of the cleft; repeat the operation on the opposite side; draw both flaps downward, bringing their cut surfaces in contact;

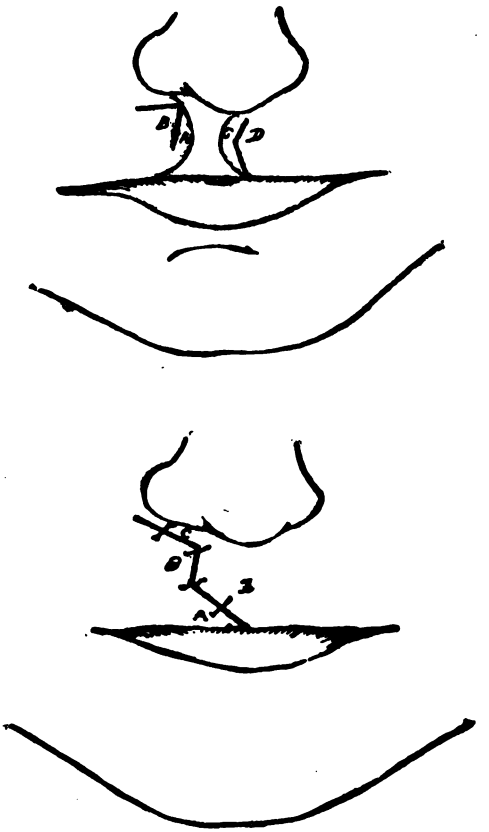
FIG. 439.

FIG. 440.

close the cleft with a pin or suture passed near to the vermillion border, and insert another above if necessary; unite the everted flaps by a fine silken thread or horse-hair; cut off their extremities obliquely, leaving enough to form a permanent projection at the margin of the lip, to obviate the formation of the notch (Fig. 439). If the cleft be shallow, the flaps should remain connected above and be turned downward and united, as before (Fig. 440).

*Double Flaps, Giralde's Method.*—This is to be employed only when the deformity extends into the nasal cavity; and the flaps are constructed so as to provide a floor to its entrance. When the flap C is carried upwards to repair the floor of the nostril, the angle of the cut B A is then brought in contact with the angle of the flap D, and their surfaces should be of a similar length. The border B then

comes in contact with D, and the point of the flap A rests upon the undermost cut, in which position they are united (Figs. 441 and 442).



Figs. 441 and 442.

*Double Hare-lip, Simple.*—Pare the central portion on either side; make lateral flaps with their attachments below, liberate the labial attachments, and approximate the raw surfaces by the aid of pins and sutures (Fig. 443).

*Complicated Hare-lip.*—Hare-lip is often complicated by a fissure through the alveolar process, which sometimes extends to the hard palate, and even beyond, to the soft parts.

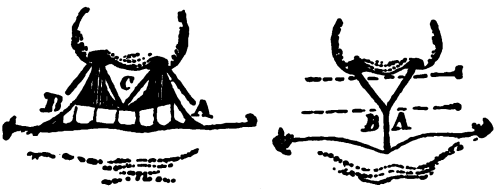



FIG. 443.

For a time before the operation it is well for the parents or nurse to make gradual pressure upon the most prominent portion combined with outward traction on the side most depressed, seeking thereby to cause the alveolar arch to assume a normal outline. A small amount of patience combined with these painless manipulations, will affect more than the application of sudden force by means of forceps. The practice of forcing the ends into position, paring, and wiring them, is a pernicious one, since, to do it destroys the outline of the arch and does not result in the union of

FIG. 444.

FIG. 445.

the extremities. The gentle, but constant traction, exerted by the united lip will as certainly reduce the bones as the more vigorous measures.

It is better to allow the deformity of the hard parts to remain unmolested until the teeth appear. When the outline of the biting surface can be compared with that of the lower jaw, and made to meet it by rectifying the upper, and introducing, if necessary, additional teeth upon a plate to fill the gap. Giralde's method offers the best opportunity of closing the fissure in the lip in these cases.

The fissure may be double, and implicate both the hard and soft parts, back to and through the soft palate. The intermaxillary bone may project freely and even be adherent to the end of the nose by means of the soft parts covering it. In the former case, after the division of the vomer, or the removal of a triangular piece from the septum, the projecting portion is forcibly pressed into position, and the soft parts united in the usual manner; except, perhaps, it may not be prudent to unite both sides simultaneously, on account of causing too great traction.

If the protrusion be connected to the nose, it should be separated with care, otherwise the columna will be impaired. The portion removed is to be utilized in repairing the upper lip, when practicable (Fig. 444). The cheek compressor, designed by Hainsley, can be utilized when the circumstances require it (Fig. 445).

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## CHEILOPLASTY.

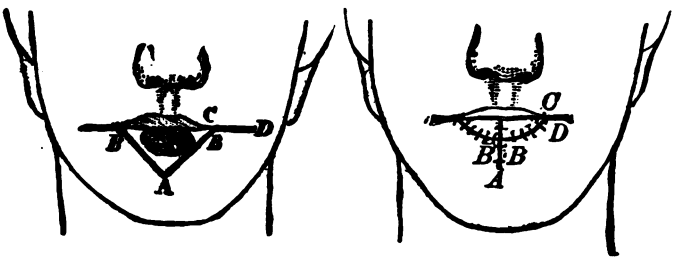
*Lower Lip, V incision.*—This is employed for the removal of an epithelioma or other morbid growth, that does not necessitate the elimination of more than one third of the lip. The whole thickness of the lip is divided; the length of the V depending upon its width at the base. The same liberating incisions may be required, and the cut surfaces are united by the same means and cared for in the same way as for hare-lip (Fig. 446).

*Method of Celsus.*—When the morbid growth involves the whole or half of the lip, the broad based V incision is supplemented by transverse ones extending from each angle of the mouth, a sufficient distance to admit of the easy

joining of the V borders after the tissues have been freely liberated from their bony attachments (Figs. 447 and 448). The most ingenious feature of this method consists in dividing the buccal mucous membrane at least a fourth of an

FIG. 446.

inch above the incision through the cheek and parallel with it, so that when the transverse cuts are completed, and the parts joined in the median line to form the lip, its raw borders can be covered by turning over it the processes of




FIGS. 447 and 448.

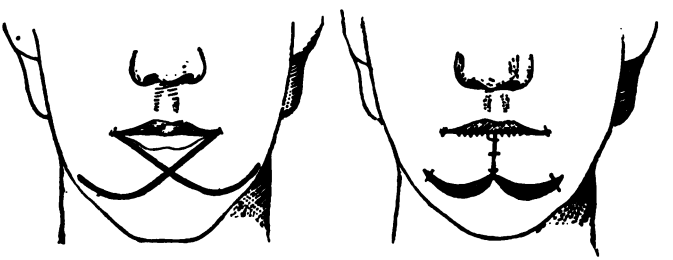
mucous membrane, thereby providing an excellent vermillion border. The angles of the mouth are also to be formed by stitching the membrane and buccal cuts together.

*Horizontal Incision* (Fig. 449).—When the morbid process does not involve the free borders at the mouth, it can be removed by an oval incision, and the gap closed in the usual manner. If too large to admit of closure, it can be left to heal by granulation, or be remedied by the sliding

FIG. 449.

process, either with or without the parallel or transverse incisions.

*Syme's Method* (Figs. 450 and 451).—This is accomplished by continuing the sides of the V downward and outward in a curvilinear direction about two inches, dissecting up the flap in the usual manner, raising them up to form the



FIGS. 450 and 451.

lip, uniting them in the median line, and allowing the remaining portion to heal by granulation. The mucous membrane should then be stitched to the integument, to provide a suitable border.

*Buck's Method.*—He first removed the morbid growth by

the V-shaped incision, and united the parts in the usual manner. After union had taken place, the short under lip was overhung by the upper, giving to the patient a sucker-mouthed appearance (Fig. 452). The steps taken to relieve this deformity can best be described in Dr. Buck's own language: "In order to insure precision in making the requisite incisions, their course should first be designated by pins, temporarily inserted erect in the skin at certain points, as shown by (Fig. 453). Letters *a a* represent two pins inserted at one finger's breadth below the under lip border, one on either side of the chin, a little to the outside of the angle of the mouth, and both equidistant from the median line. *b b* are also two pins inserted, one

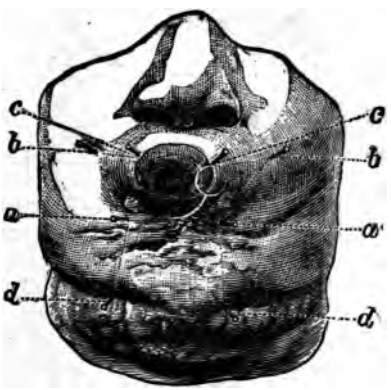



FIG. 452.

on either side, into the upper lip at the margin of the vermillion border, both equidistant from the median line, and at such a distance apart as to include between them sufficient length of lip border, with which to form a new upper lip. The steps of the operation are then the following: with the forefinger of the left hand placed on the inside of the mouth, the cheek is held moderately on the stretch, while with a sharp-pointed knife it is transfixed at the point, as marked by the lower pin in the side of the chin. An incision is then carried through the entire thickness of the cheek upward and a little outward a distance of one inch and a half to a point *c*, near the middle of the cheek. The left half of the upper lip should next

be transfixed at the point *b*, marked by a pin on the vermillion border, and the incision carried through the lip and cheek upward and a little outward, a distance of one inch and a half to a point *c*, near the middle of the cheek. The left half of the upper lip should next be transfixed at the point *b*, marked by a pin on the vermillion border, and the incision carried through the lip and cheek outward and a little upward to join the first incision at its terminus *c* in the middle of the cheek. A triangular patch, *b*, *c*, *a*, will thus be formed, which will include the entire thickness of the cheek, with its apex free and disconnected, while its

FIG. 453.

base remains attached toward the mouth. The next step is to transfer the patch from the cheek to the side of the chin. For this purpose an incision should be made on the side of the chin from the starting-point of the first incision vertically downward to the edge of the jaw and to the depth of the periosteum. The edges of this incision retracting wide apart, afford a V-shaped space for the lodgment of the triangular patch, which is now to be brought around edgewise and adjusted by sutures in the new location. By this transfer the portion of the upper lip border that formed a part of the base of the patch, is brought into a transverse

line, continuous with the upper lip, and forms an extension of it. The space upon the cheek from which the triangular patch was taken is closed by bringing its edges together and securing them by sutures. By this adjustment a new and naturally shaped angle is formed for the mouth at the

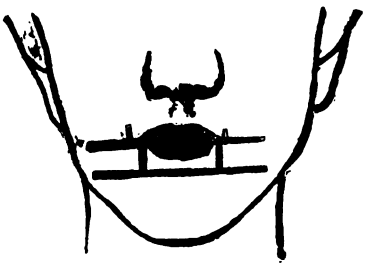


FIG. 454.

point *b*, where the lip was transfixed in commencing the second incision of the cheek. The incisions should be made with the utmost precision, and special care should be taken that the lining mucous membrane is divided exactly to the same extent as the skin. The same proceed-

FIG. 455.

ure may be applied to the other side of the mouth and executed at the same operation."

*Malgagine's Method* (Fig. 454).—The growth is removed by two vertical and a horizontal incision on each side, the

former beginning at the angles of the mouth and the other at the lower portion of the gap. They are freely separated, brough tforward, united in the median line, and the mucous membrane stitched to the integument. The mucous membrane can in this instance be taken with the cheek flap to form the vermillion border, as in Celsus' method.

*Sédillot's Method* (Fig. 455).—The growth is removed as in the preceding method, after which the vertical incisions are extended to the lower border of the jaw, then backward far enough to make flaps of sufficient width to fill the gap; then vertically upward to a point opposite the angle of the mouth.

These flaps are dissected up, and united in the median line in the usual manner.

FIG. 456.

*Upper Lip.*—If the deformity here be slight, it can be remedied by the simple means employed upon the lower.

*Intero-lateral Flap* (Buck).—This operation was done to restore one half the upper lip and the adjacent portion of the cheek (Fig. 456). Divide the under lip where it joins the cheek by a vertical incision at right angles with its border, one inch in depth, *a*, *b*. Make a second, one inch and a half in length, beginning at the lower end of the first, *a*, *b*, and running forward parallel with the border of the lip, *b*, *c*. An oblique incision about half an inch in length is

then made upward and forward from the end of the horizontal one, leaving the flap with a good attachment at this point. Pare the edges of the deformity and the end of the half lip; separate the former from its bony attachments by free section of the underlying tissues upward towards the orbit; the under lip flap is then tipped endwise, and its upper extremity connected by sutures with the end of the upper lip. The remaining space between the flap and the cheeks is closed by sutures.

*Entire Loss of the Upper Lip.*—This deformity may be repaired by semicircular or vertical flaps.

FIG. 457.

*Semicircular Flap Method* (Buck).—Commence an incision at the median line, on a level with the floor of the nasal cavity on either side; carry it outward and downward in a semicircular manner below the lower lip to a point corresponding to its middle third *a*, *b*, (Fig. 457). These incisions are to be carried through the entire thickness of the cheeks and lips at a uniform distance of an inch and a

quarter from the border. Dissect up the remaining portions of the cheeks freely from their attachments beneath, that they may be easily brought forward. The upper ex-

FIG. 458.

FIG. 459.

tremities of the semicircular flaps are trimmed off at a proper angle *c*, *d*, after which they are united in the median

FIG. 460.

line by the usual means. The interval between the cheeks and the newly constructed mouth is closed by sutures.

*Vertical Flap Method* (Sédillot).—Their bases may be either upward or downward, the former being the better. The flaps comprise the entire thickness of the cheeks; their length and width corresponding to the dimensions of the new lip, plus the allowance for skrinkage (Fig. 458). They are carried upward into position, and united in the median line. The gaps in the cheek may be closed by sutures, or allowed to heal by granulation (Fig. 459).

*Stomatoplasty.*—This operation is employed to increase the

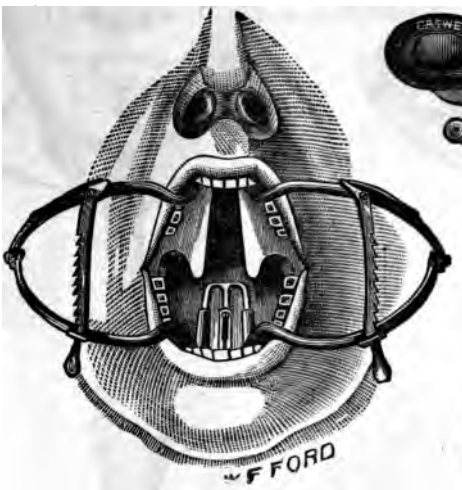



FIG. 461.

FIG. 462

size and regulate the shape of the mouth, resulting from disease or from previous operations.

It can be corrected by an operation already described (see Fig. 455) when the lower lip is the contracted portion. Its angles may be formed by the means of transverse incisions, made at the proper situation. Whenever this is done the mucous membrane must be stitched over the raw surface, else they will grow together.

The operation described by Buck for restoring the angles of the mouth is a most simple and effective one (Fig. 460). An incision is made with great exactness along the line of the vermillion border, circumscribing the circular half of

the mouth, and extending to an equal distance in the upper and lower lips, *a* to *b*. This incision should only divide the skin, and not involve the mucous membrane. A sharp pointed double-edged knife should then be inserted at the middle of this curved incision and directed towards the cheeks, flatwise, between the skin and mucous membrane, so as to separate them from each other as far as the new angle of the mouth requires to be extended.

The skin alone is next divided on a line with the commissure of the mouth, outward toward the cheeks *d* to *c*. The underlying mucous membrane is then divided in the

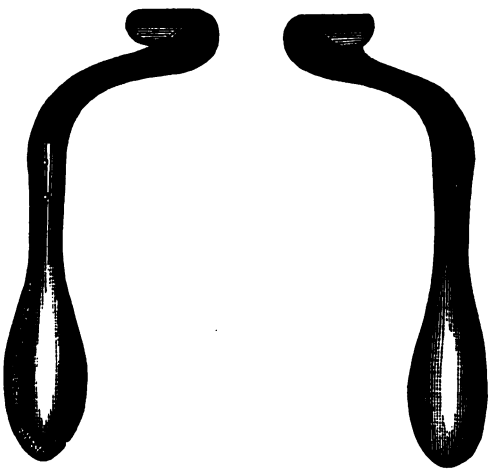


FIG. 463.

same line, but not so far outward. The angles at the outer ends of the two incisions are accurately united by a single thread suture. The fresh cut edges of skin and mucous membrane above and below that, are to form the new lip borders, are to be shaped by paring first the skin and then the mucous membrane in such a manner that the latter shall overlap the former after they have been secured together by fine thread sutures at near intervals.

*Palate.*—The operations employed to relieve the deformities of the hard and soft palate are denominated staphyloplasty and uranoplasty. The instruments required are the gag, for the purpose of holding the mouth well opened

(Figs. 461 and 462); cheek retractors (Fig. 463) seizing forceps (Figs 464 and 465); variously shaped knives for refreshing the borders (Fig. 466); tenaculum employed in holding the flaps, etc. (Fig. 467); curved scissors (Fig. 468); periostiotomes (Figs. 469 and 470); spiral needles for sutures (Fig. 471); suture adjuster (Fig. 472); forceps for twisting wire sutures (Fig. 473); oral saw (Fig. 474); hoe for dividing the muco-periosteal membrane (Fig. 475); sponges, sponge-holders, etc.

*Staphyloplasty* consists in closing an abnormal opening in the soft palate. The openings vary from simple cleft of

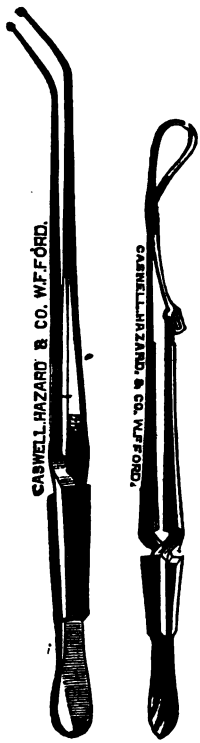



FIG. 464.




FIG. 465.

FIG. 466.

FIG. 467.

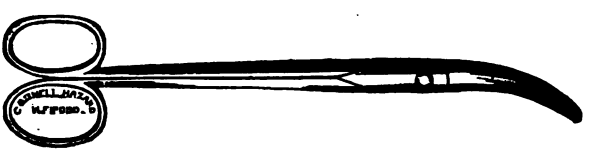


FIG. 468.

FIG. 469.

FIG. 470.

FIG. 471.

FIG. 472.

FIG. 473.

FIG. 474.

FIG. 475.

FIG. 476.

FIG. 477.

FIG. 478.

the uvula to a complete fissure of all the soft parts (Figs. 476, 477, and 478). Some time prior to the operation, the patient should be instructed to properly control the fauces that the surgeon may handle the parts without causing involuntary movement of them. If the fissure be a small one, it can be closed without further preparation.

The patient is placed in a chair which will admit of the head being thrown well back, with the parts exposed to a strong light; the lower point of the cleft is then seized with the forceps, made tense, and the border freshened from be-

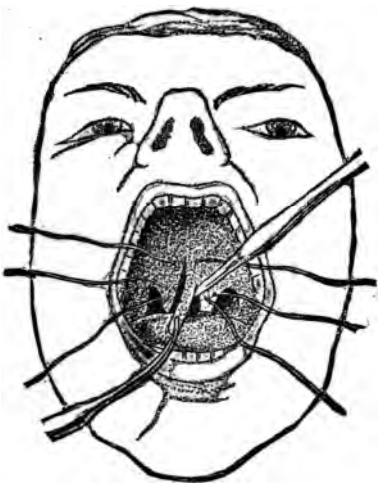


FIG. 479.

low upward (Fig. 479), or the reverse, if desired. Treat the opposite side in the same way, and unite with sutures in a manner hereafter to be described. If the cleft extends through the whole of the soft palate, even encroaching somewhat upon the hard portion, it will be necessary, especially if the gap be a wide one and the muscles controlling it be active, to destroy their influence before attempting to unite the cleft. The tensor and levator palati muscles, together with palato-glossi and pharyngei are the ones that exercise contraction on the part, and if they be properly severed, the velum will remain motionless and flaccid. The accompanying illustration shows their relations to the surrounding parts (Fig. 480).

The palato-pharyngei muscles are cut by dividing the posterior pillars of the fauces, of which they are the principal part, with a blunt-pointed scissors. The palato-glossis muscles, comprising the anterior pillars, may be cut in the same manner. The remaining muscles are divided by

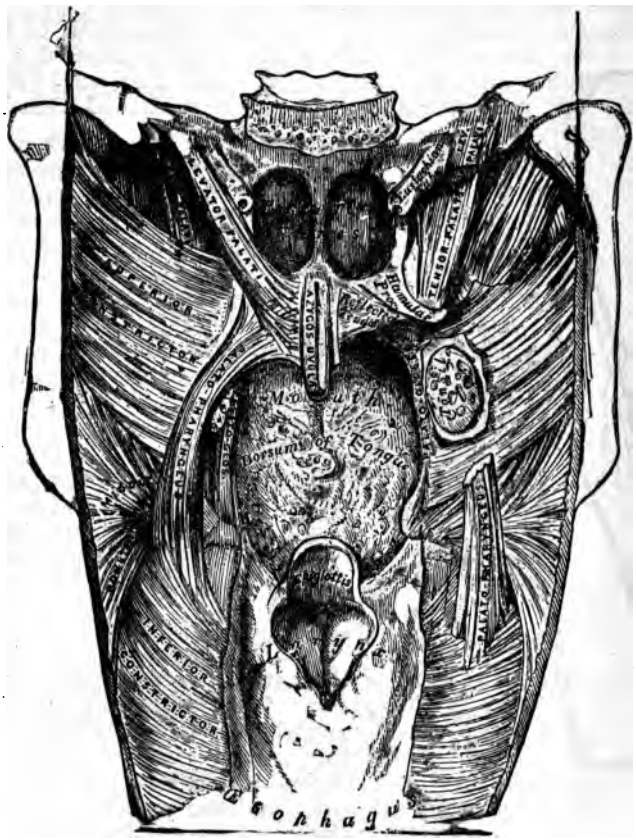


FIG. 480.

first passing a silken thread, on each side, through the velum at a point corresponding to the origin of the uvula; loop the extremities and use the hooks to make the velum tense while the following muscles are divided:

*Tensor Palati.*—Recognize the hamular process around which its tendon runs, a little behind and internal to the posterior molar tooth. Make tense that segment of the velum by the suture just introduced, and enter the point of a narrow-bladed knife a little below and at the inner side of the process, with the edge upward; carry it upward, backward, and inward, until the point is seen through the gap; this divides almost the entire width of the velum, with the main if not the entire portions of the tendon of the tensor-palati.

FIG. 481.

*Levator-palati.*—Many of the lowermost fibres of this muscle will be cut by the preceding incision. If a greater section be required, depress the handle and carry it outward, so as to make an oblique incision on the posterior surface of the velum as it is withdrawn. It is well to allow two or three days to elapse before attempting the union of the cleft, to allow hemorrhage and inflammatory action to subside and to more clearly determine if further section will be required.

There are three steps to the operation of staphyloplasty: 1. Freshening the edges of the cleft. 2. Passing the sutures. 3. Coapting the divided borders, and tying the sutures. The first step is done as before described (Fig. 479); the patient is allowed to rest

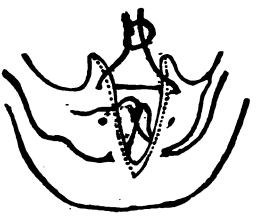


FIG. 482.

after its completion, until the hemorrhage ceases and self-control is regained. The sutures should be one yard in length, and doubled before passing, and thoroughly antiseptic. Three or four are usually sufficient. The first should be introduced at the middle, the second at the lower extremity of the gap, while the remaining ones close

the spaces between. They can be passed from before backward on one side, and from behind forward on the other, by the means of the needle-holder and the ordinary short curved needle (Fig. 481), or in the following manner by the means of the spiral needle figured at the head of this chapter.

Seize the flap on the left side with a pair of forceps, and carry the needle through the point selected from before backward; draw one end of the suture through between the lips of the wound; withdraw the needle and pass it on the opposite side in the same manner; catch the thread and withdraw the needle, leaving the looped suture in the flap (Fig. 482); then pass the end of the ligature, first inserted, through the hook, which is then drawn out, carrying the single thread through the opposite side.

The remaining sutures are then passed in a similar manner. Each one is then tied somewhat loosely, to allow for the swelling, with a reef knot, or what is better, the slip knot, held in place by a second knot over it. Perforated shot may be passed over the sutures and held in position by compressing them, or by the ordinary knot. If silver wire be used, it must be very fine and flexible, and applied with an adjuster. The sutures should be cut sufficiently long in either instance to admit of their easy removal, which is done at the end of a week. The diet should be plain and all conversation interdicted. The prospect for union of the parts is very favorable, scarcely more than five per cent being failures. The length of time taken to secure return of voice is variable, and oftentimes it never occurs.

*Uranoplasty.*—This is done to close a fissure in the hard palate. It should not be attempted before two years of age, and not then unless the patient be in all respects in perfect health. It can be done at one or may require several sittings, depending on the obstacles to be overcome.

If it be complicated with a complete cleft of the soft palate, they should be treated separately. If, however, it be partial, both can be attempted at the same sitting, when the soft portion should be united first, and in the same manner as before, to prevent it being obscured by blood.

This operation consists of four stages: 1. The paring of the edges of the fissure; 2. the making of a longitudinal curvilinear incision along the alveoler process close to the teeth (Fig. 483); 3. the raising of the muco-periosteal flaps from the roof of the mouth; 4. their union along the

median line. The patient is anæsthetized, placed in a chair facing a good light, the gag introduced, and the first step performed easily with an ordinary knife and forceps. The flaps are made by beginning the incision at the posterior border of the last molar tooth, or more practically in front of the hamular process, and carrying it down through the periosteum and forwards along the inner margin of the alveolar process to the line of junction be-

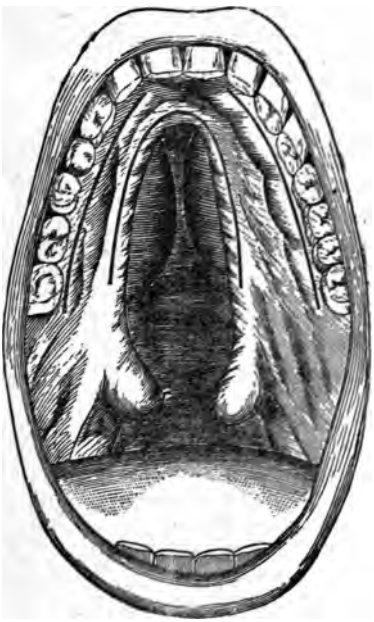


FIG. 483.

tween the lateral and middle incisors. If the curvilinear incision be at the base of the alveolar process, or be carried forward to the central incisors, the posterior and anterior palatine vessels will be divided. These flaps should now be carefully detached by a periosteotome from without inward and from before backward until the edges of the fissure are reached; they are then carried toward the median line, and if no degree of traction be

noticed, united throughout to each other by silver sutures. The displaced periosteum fills in the gap and often develops sufficient bone to produce an admirable degree of firmness. The sutures are allowed to remain ten days or two weeks, patient is fed on liquid food, any cough is relieved by anodynes, and the parts kept clean.

Langenbeck closed the fissure by two flaps, formed by an antero-posterior division of the hard palate on either side of it: refreshed their contiguous borders and pushed them against each other at the median line, where the mucous membrane was united by sutures, the anterior and posterior extremities of the osseous flaps being still connected with the soft parts.

Ferguson divided the hard palate with a chisel. Mears uses Adams' saw after drilling an opening for its entrance, and claims less injury to the bone than by any other means. The hemorrhage is quite severe during the removal of the periosteal flaps, but is readily controlled by pressure and cold. When the osseous flaps are made, the bleeding is still greater, if anything. If the fissure be not in the centre, the flap is to be taken from the side having the greatest width.

Lennelougue closed the opening by taking a properly shaped flap of the mucous membrane from the septum, its base being lowermost, and stitching it to the opposite side of the chasm.

Mechanical means are employed to fill the opening in the hard and soft parts, and to provide even an artificial uvula. This apparatus is made of vulcanized rubber, and is held in position by being attached to a plate having false teeth, or by an obturator. The ability to speak and to otherwise use the forces of the throat and pharynx with this contrivance is very satisfactory; in the majority of instances equalling, if not exceeding, the best results from operation.

*Staphyloplasty* consists in filling in the gap of the soft parts, and as much as possible of the hard, by a flap taken from the posterior wall of the pharynx, base downwards, and fitted carefully to the deformity. The degree of success attending this attempt is sufficient to warrant its continuance when the conditions demanding it are present.

*Elongated uvula* is easily shortened by causing the patient to withdraw the tongue by aid of a dry towel; seize the end of the uvula with forceps and remove the desired part with scissors.

## SALIVARY FISTULA.

In this condition the saliva is discharged on the external surface instead of into the mouth. The object of the operation is to establish an internal communication so that the external opening can heal.

The cure may first be attempted by passing the ends of several long silken threads through the external opening into the mouth directly, or through the internal opening of the duct and bringing them out to the angle of the mouth and tying them to the opposite extremities. (Fig. 484.)

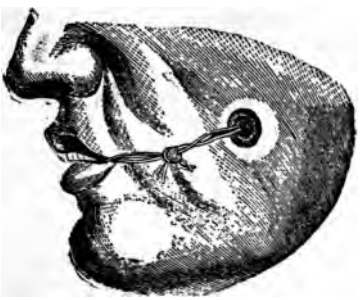


FIG. 484.

The internal communication is usually established in eight or ten days, when the seton can be removed and the external opening refreshed and closed. The patient should be taught to lie and to chew upon the opposite side during the healing. Another method consists in passing a good-sized thread of silk into the mouth, through the fistula, from without inwards, and leaving it there; remove the needle and attach it to the end of the thread remaining outside, and carry it likewise into the mouth in the same direction as the former, but not on the same track; remove the needle and tie the extremities firmly within the mouth. A fine rubber ligature can be substituted for the silk. The loop cuts its way through the tissues grasped, causing an internal opening, which permits the healing of the external one.

The method recommended by Dr. Homer, which is employed in obstinate cases, consists in the introduction of a wooden spatula into the mouth, opposite the site of the

fistula, upon which, by means of a saddler's or other suitable punch, the diseased tissues, duct and all, are removed (Fig. 485), and the external opening closed, followed by

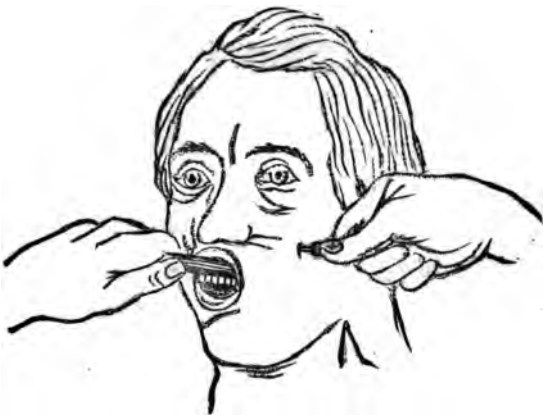


FIG. 485.

quietude and cold, dry dressing. The end of the duct can be dissected out and passed through an opening made into the mouth and the external portion closed.

## EXCISION OF TONSILS.

This can be done by an ordinary tenaculum and bistoury or by curved scissors. The various forms of tonsilotomes, while they simplify the operation by giving the operator a perfect control over the cutting edge, are not necessary to its execution.

*To Remove the Tonsil with the Knife or Scissors.* — If the patient be young or unable to retain self-control, give an anæsthetic. Secure a good light into the open mouth, depress the tongue, seize the tonsil with the tenaculum or forceps, draw it inward from between the pillars of the fauces, and with scissors curved on the flat, or the probe-pointed

bistoury, or an ordinary one with the point guarded with adhesive plaster, sever the growth from below upward. It is not necessary to remove the entire tonsil, since a curative

FIG. 486.

influence is often established by its incomplete removal. Among the forms of tonsilotomes in common use are Tie-

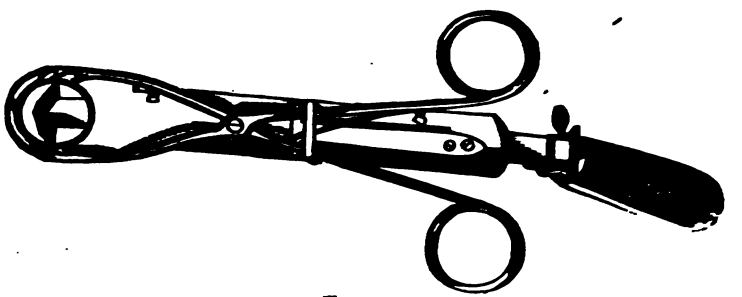


FIG. 487.

man's (Fig. 486) Hamilton's (Fig. 487), Mackenzie's (Fig. 488), and various others, the majority of which combine the ability to seize, hold up, and sever the growth. Prepare

the patient as before, and with the index finger adjust the ring of the instrument around the tonsil properly, elevate

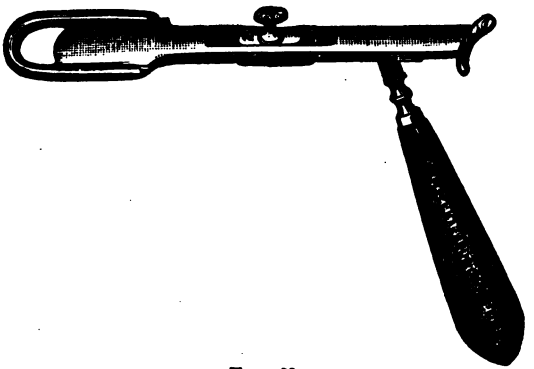


FIG. 488.

it with a tenaculum, and sever by pressing the knife against it. Any undue hemorrhage can be controlled by ice and pressure.

## OPERATIONS ON THE TONGUE.

It is often necessary to remove the tongue in part or entirely on account of hypertrophy, malignant and other growths. The arteries going to it are the dorsalis linguæ, ranine, and branches from the ascending pharyngeal. The ranine is the principal branch and runs along the under surface from its base to the apex. The buccal, sublingual and submaxillary glands are closely associated with it in a surgical sense. The facial and sublingual arteries will not be endangered, except the floor of the mouth be attacked in conjunction with the tongue. It will be remembered that the circulation in the respective sides of the organ does not communicate freely; owing to this fact the ligaturing of the lingual artery of one side will permit of free incision on that side with but trifling hemorrhage.

*Tongue-tie.*—This depends on an undue extension forward of the frænum linguæ, either with or without an

abnormal shortening of it. If the condition be severe enough to call for treatment, the end of the tongue should be pressed upward by the first two fingers passed beneath it, palm downward, bringing the tense frænum between them on the palm's surface, where it can be divided with a blunt-pointed scissors at a little distance from, but parallel with its under surface, being careful not to sever the ranine artery.

*Ranula.*—The closure of the salivary ducts of the sublingual glands causes a cystic distention of them. If it be not possible to find and probe their openings, it will be necessary to evacuate the collection in the floor of the mouth below the tongue; or, if the tumor be of large size, it may be done in the median line externally, close to the hyoid bone. In either instance it may be necessary to pack it with lint and liquor ferri-sulphatis, or cauterize the sack with nitrate of silver, and even to dissect it partially or entirely away.

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## EXSECTION OF THE TONGUE.

The tongue may be removed with the knife, scissors, galvanic cautery, écraseur, or ligature. The last should be excluded, as the time required and the pain caused is greatly in excess of the other methods. If the diseased portion be small, it may be taken away by the form of incision best calculated to accomplish the object, since it is not a good plan to secure symmetry at the expense of future safety. If the hypertrophy involves the apex, or if a tumor be located at this situation, it can be excised by removing a V-shaped piece in the following manner:

Anæsthize the patient, place him in a chair in a strong light with the mouth well opened by a gag, or any suitable substance, with a string attached, forced between the posterior molars. Pass a stout ligature through each side of the tongue, just outside of the intended site of the apex of the V incision; loop them; give each to an assistant with instructions to pull the tongue forward; seize the tip with a pair of forceps, or between the thumb and finger, and with a sharp-pointed, narrow-bladed knife transfix the

organ from below upward at the point of the V posteriorly, cutting outward and forward through its borders; check the points of severe hemorrhage with forceps or serres-fines

FIG 489.

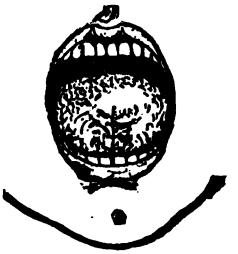

FIG. 490.

and make the incision on the opposite side in a reverse direction back to the apex of the cut (Fig. 489). Liga-

FIG. 491.

ture the bleeding points and unite the flaps by sutures in the usual manner (Fig. 490).

*Hypertrophy of the Tongue* (Fig. 491), involving its entire

structure, can be treated by the removal of a V-shaped piece in the manner just described. This will shorten its transverse diameter and diminish its length. The flaps are then united as before, and after healing, its thickness can be lessened by first passing a strong ligature laterally through it near to the base, by which it is drawn forward and held while a wedged-shaped piece is removed by transfixing laterally as far back as possible and midway between its upper and lower surfaces.

First make the under flap by cutting downward and forward through its under surface. Make the upper flap by applying the knife above the last incision. Ligature the bleeding points, and unite with sutures.

*Half of the organ* can be removed by first ligating the lingual artery corresponding to it, after which it can be cut away with the serrated scissors or the knife; the former being the better of the two. Ligature the bleeding points, and allow it to heal by granulation.

*Removal of the Entire Tongue.*—This can be done through the mouth or beneath the inferior maxilla, or by division of the lower jaw at the symphysis, or at either side of it. It can be removed through the mouth by the knife, scissors, the galvano-cautery, or the écraseur. When the knife or scissors are to be employed, it is the usual procedure to ligate both arteries to prevent the profuse hemorrhage which must otherwise occur; after which a stout thread is passed through the tongue at the junction of the middle and anterior thirds, by which it is drawn forward and upward and detached from its connections with the jaw and pillars of the fauces; the muscles of the tongue are then divided by scissors, as closely to the under surface as the disease will permit, back to near the larynx. The glosso-epiglottidean folds are then commanded by passing a long ligature through each, which is allowed to remain, in order that the floor of the mouth may be drawn forward in the event of secondary hemorrhage. The excision is then completed; all bleeding points checked, and the surface heals by granulation.

Mr. Whitehead, of Manchester, has frequently operated in this manner with great success, without the preliminary ligation of the linguals; tying the bleeding points as they present themselves. The écraseur offers an admirable means of removing the whole organ, with less danger from hemorrhage than the use of the knife or scissors; the re-

sults too are equally satisfactory. It may be applied through the mouth, or by way of free puncture made with a stout, sharp-pointed knife introduced from without between the hyoid bone and the jaw, a little nearer the latter, and entering the floor of the mouth near the frænum. The wire or chain is then passed through this opening, around the base of the tongue, in which position, after the tongue is well drawn forward, it is confined by means of three or four stout hair-lip pins passed at short intervals through its base from side to side; after which it is slowly and carefully severed. If the tongue be drawn forward in the usual manner and freely detached from its connections with the jaw and floor of the mouth, the same instrument can be quite as readily applied without the submental puncture. The use of the écraseur for complete ablation can be recommended with confidence; and should, if accessible, be selected in preference to the galvano-cautery, which is much more liable to be followed by secondary hemorrhage.

*The removal below or through the jaw* does not offer the chances of success enjoyed by the former methods. The operation devised by Regiroli offers easy access, but creates a large and somewhat dangerous wound. A crescentric-shaped incision is carried along the base of the lower jaw (Fig. 492), extending from in front of its angles. A vertical one is then made from the centre of this one to the median line of the hyoid bone. The flaps are then reflected, and the attachments of the lingual and hyoid muscles divided from the surface of the lower jaw. The tongue is drawn through the opening and severed by the knife or écraseur, the bleeding points being secured as fast as they appear, the flaps united, and the remaining portions allowed to heal by granulation.

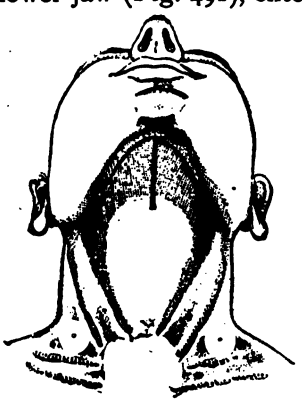

FIG. 492.

Knox made a vertical incision through the lower lip down to the hyoid bone, extracted a tooth, and sawed through the symphysis mentis. The mucous membrane and muscular attachments were then divided, *lingual arteries* cut and tied, and the tongue removed close

to the hyoid bone. Mr. Heart employed the écraseur instead of the knife. Sédillot made an L-shaped section of the bone to prevent the fragments from sliding after approximation. Billroth divided the jaw at the canine and last molar teeth, and wired the fragments after the removal of the tongue.

If the floor of the mouth be involved in addition to the tongue. Billroth made an incision about one inch below the border of the lip from one facial artery to the other; at the ends of this incision he made two vertical ones about four fifths of an inch below the border of the bone, at which points he divided the jaw and turned it downward along with the soft parts, thereby affording ample room to reach the soft parts within. As before remarked, the operation which involves the bone and the soft parts around it results less favorably than when the tongue is removed through the mouth by the methods described for that purpose; the rate of mortality in removal of the tongue by all of the methods is considerable, 56 out of 244 cases having died.

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## ŒSOPHAGOTOMY.

It sometimes becomes necessary to open the œsophagus on account of obstruction due to foreign bodies lodged in its cervical portion. It is well to recall the fact that the œsophagus begins opposite to the cricoid cartilage, and is located, in this region, somewhat to the left of the median line. The situation of the foreign body is usually marked by a greater or less prominence on the left side, below the cricoid cartilage; or, if this be not manifest, the exact site of the canal can be demonstrated by the introduction into it, through the pharynx, of a good-sized bulbous, or other probang. The following are its important surgical relations in the cervical region: In front, with the trachea, above; and below, with the thoracic duct and the thyroid gland; behind, the vertebral column and longus colli muscle; at the sides, with the common carotid arteries, especially the left, thyroid lobes and recurrent laryngeal nerves that lie between it and the trachea.

Always employ an anæsthetic; place the patient on the *back, with the chest* and shoulders elevated and the head

turned to the opposite side; feel for the foreign body, and when found, make the incision directly at that point.

If the foreign body be not discernible, make an incision about four inches in length on the left side, between the sterno-mastoid and trachea, beginning at the upper border of the thyroid cartilage. The platysma and fascia are divided on a director; the borders of the wound separated, the omo-hyoid is drawn outward, the sterno and thyro-hyoid inward; this exposes the sheath of the carotid, which is carried outward and retained; the lobe of the thyroid gland is raised and carried inward; the larynx carefully outlined and drawn forward and held while the location of the foreign body is sought for; if not present or distinguishable, the bulbous probang is then introduced to mark the outline of the tube, which is then opened sufficiently to admit the finger, carefully avoiding the recur-

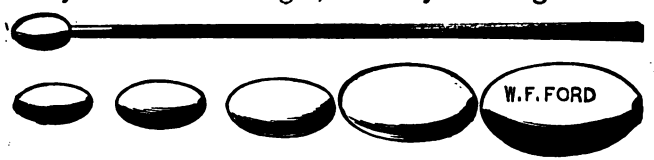


FIG. 502.

rent laryngeal nerve. The obstruction is located by passing the finger into the tube and removed by suitable forceps, aided by manipulations from without and by lengthening the incision if necessary. Close the opening in the œsophagus with fine catgut; unite the external incisions in the usual manner and dress antiseptically. The patient should for a few days subsist on liquid food, introduced through a tube.

*Fallacies.*—The foreign body may be mistaken for an enlarged gland on external examination. The œsophagus may be confounded with the longus colli at first; however, a moment's examination will serve to dispel the doubt. If the probang be introduced, the exact location will be established.

Thirty-nine cases are reported, of which six died; but from causes independent of the operation.

*Stricture of the Œsophagus.*—This condition depends upon a circumscribed inflammatory action or other morbid process, involving one or more coats of the tube, causing a narrowing of its calibre, which manifests itself proportionately to the degree of constriction. It may be limited to one side,

or involve the whole circumference of the tube. The most frequent site is opposite the cricoid cartilage, or where the pharynx and œsophagus join. The stricture is to be treated by dilatation, for which purpose various forms of dilators have been designed (Fig. 502). These and all other forms should be introduced by extending the neck and passing the instrument carefully downward in contact with the poste-

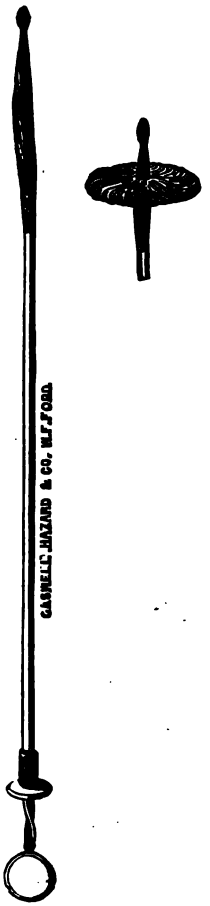


FIG. 503.

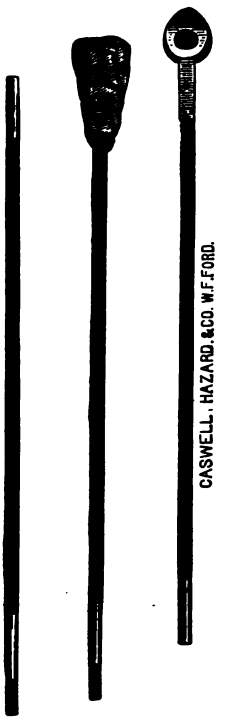


FIG. 504.

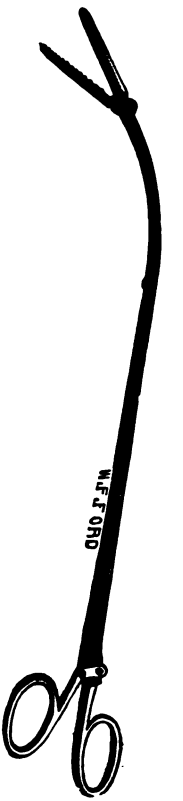


FIG. 506.

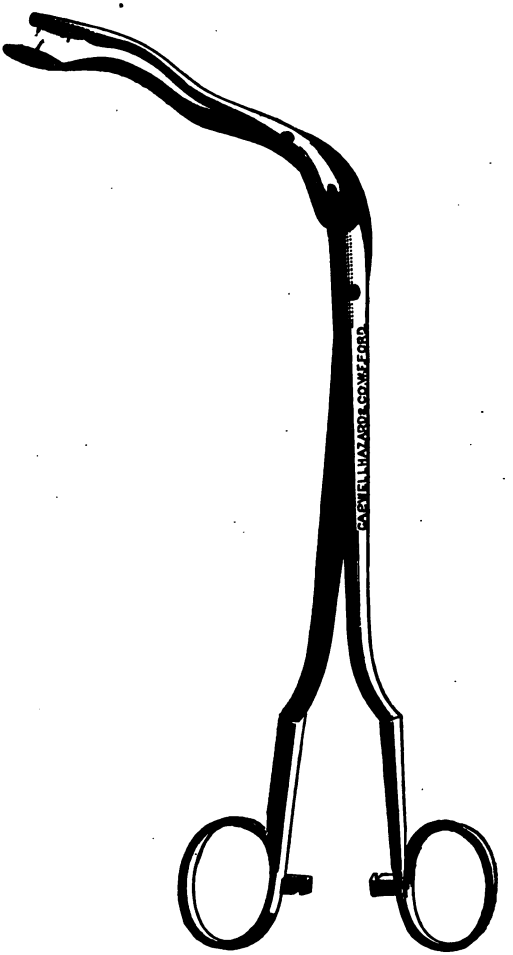


Fig. 505.

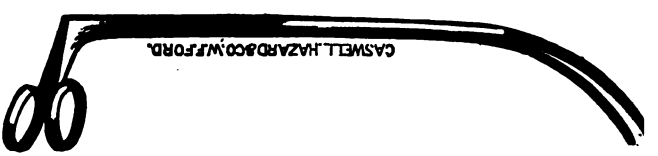


Fig. 507.

rior portion of the pharynx. No force should be employed for fear of causing a false passage. The surgeon should always eliminate the possibility of aneurismal constriction of the tube before an attempt is made to overcome it.

The removal of foreign bodies from the œsophagus is accomplished by probangs (Figs. 503 and 504) and various forms of long forceps (Figs. 505, 506, and 507). The sponge extremity of the probang can be used where unusual caution is desirable in exploring the passage.

*Œsophagectomy.*—This consists in excising a portion of the cervical œsophagus through an incision made in the same manner as for œsophagotomy, for the removal of a cancerous growth. The upper end of the lower portion of the tube is then raised forward and united to the wound; thereby forming an opening through which food may be introduced by means of a tube.

*Œsophagastomy.*—This procedure is employed to establish a fistulous opening, with the tube, below the point of an incurable, impassable constriction. It provides for the introduction of food into the stomach, and serves as a temporary palliative measure.

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## WOUNDS OF HOLLOW VISCERA, COVERED WITH SEROUS SURFACES.

These may result either from external violence, or become part of the procedure necessary to remove obstructions in the intestinal tubes, or for malignant growths from the duodenum and stomach. In these operations it is important to avoid all unnecessary hemorrhage, prevent the escape of irritating matter into the abdominal cavity, and so unite the divided surfaces that they shall remain properly opposed, and be followed by perfect union. The first indication is met by carefully avoiding incisions through the line of the established course of vessels, and by the use of needles which do no not possess cutting edges, but enter the tissues by causing their separation, as when their points somewhat resemble those of the ordinary sewing-needle. To meet the second indication requires a great degree of caution irrespective of the knowledge of any established measures. The lips of the wound should always be kept uniformly

and well raised by means of forceps and other instruments of a like retentive character; or by strong ligatures passed through its borders at suitable situations. If the nature of the case will permit, the contents of the viscus should be removed before the operation.

To fulfil the third indication, sutures of various forms and methods of application are employed; the aim of all being to bring the serous surfaces in contact, and maintain them so until firm union is established. To do this, it is necessary to roll the borders of the wound inward, since the mucous surfaces will not unite to each other (Fig. 493).

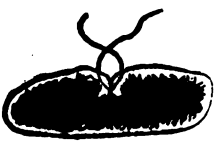

FIG. 493.

The size of the wound has much to do with its treatment. If it be of large size, it is often advisable to connect it with the opening in the abdominal walls, and allow the resulting fistulous opening to close subsequently. However small the wound, it should always be closed, or it may permit the escape of irritating matters into the abdominal cavity. As a rule, the sutures should not include the mucous surface, but extend down to it. They should not be more

FIG. 494.

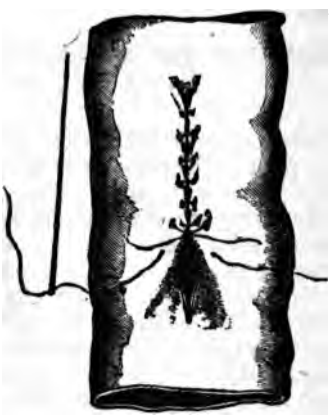

FIG. 495.

than two lines apart, nor include more than one line of the substance, and be cut short.

*Continuous Suture.*—The name defines the arrangement.

It is useful in joining long cuts of either a serous or cutaneous surface. In the latter the stitches are further apart than when applied to the intestine (Fig. 494).

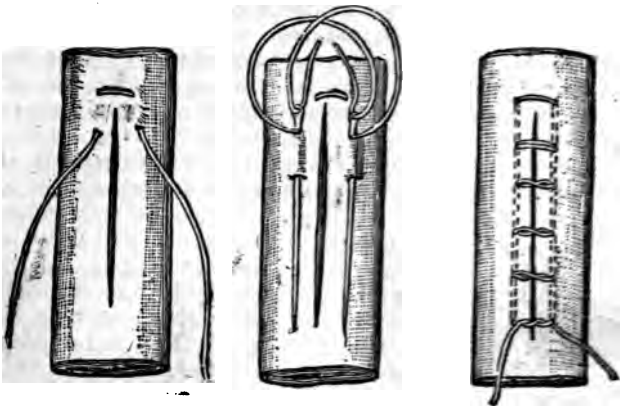

FIG. 496.

*Lambert's Suture* (Figs. 493 and 495).—This is an admirable one, easy of comprehension and application. It can be used indiscriminately in all wounds of serous membranes.

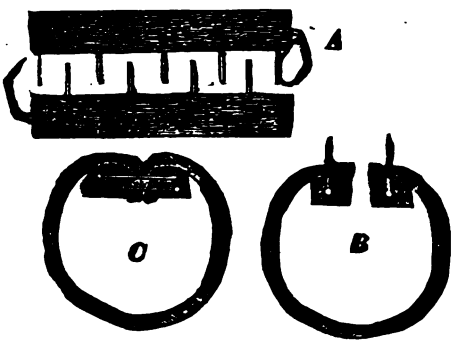


FIG. 497.

*Gely's Suture* (Fig. 496).—In this a long suture is selected and armed with a needle at each end. They are inserted near the angles of the wound, about one line from the edges, and carried along the interior of the bowel for a

sixth of an inch, then brought out precisely on the same level, so as to again appear on the peritoneal surface. The threads are then crossed, the right needle being passed through the puncture made by the left and conversely, when the ends are firmly tied and cut close as in the ordinary operation. The number of sutures will vary with the size of the cut. By this method the edges of the wound are thoroughly inverted, and all danger of extravasation prevented.

*Bérenger Féraud's Method* (Fig. 497).—Take two pieces of cork, each as long as the wound and a fourth of an inch

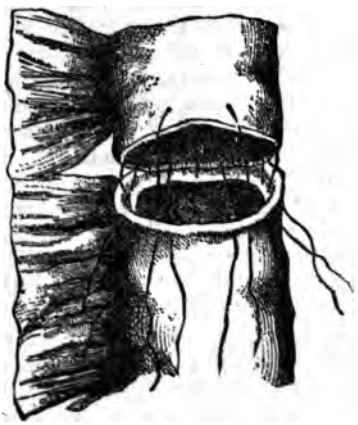

FIG. 498.

FIG. 499.

square at the extremities. Pierce each with pins about four lines apart, the points projecting a fourth of an inch on one side, and the heads pressed into the cork on the other, and covered with sealing-wax. Place them inside the intestine, one at each side of the wound and parallel with it; force the pins through from within outward, an eighth of inch from the border of the wound. Turn the points of the pins towards each other, and press the pins of each into the other, *c*. This ingenious method holds the sides of the wound in position accurately. There is a liability, however, to separation of the strips, which would cause great damage to the intestine in passing out. To obviate this danger, it has been suggested to unite their

extremities by a bent pin. The strips should come away by the bowel united by the pins.

*Jobert's Method.*—When the division is complete, the lower end is turned in for a short distance, the upper pushed within it, and the serous surfaces united by fine sutures (Fig. 498). It will be necessary to separate the messentry from each extremity for a short distance in order to permit of the coaptation just described (Fig. 499). If the messentry be separated unnecessarily sloughing of the intestine is liable to occur.

*Operations on the Stomach.*—It sometimes becomes necessary to open into the cavity of the stomach to remove foreign bodies, or to establish a permanent communication with it through the abdominal walls, for the purpose of supplying alimentation. It is therefore very important to understand its relations to the abdominal walls, and likewise to other contiguous parts. It lies principally in the epigastric and left hypochondriac regions. Its anterior surface is directed upward and forward and is in relation to the diaphragm and the under surface of the left lobe of the liver; and unless empty or adherent posteriorly, comes in contact with the abdominal walls in the epigastric region. It is altered in its position and relations by the act of breathing; descending with inspiration and ascending with expiration; when empty it retires posteriorly and is covered by the left lobe of the liver. The transverse colon lies at its lower border when it is moderately distended. The *contiguous guides to the stomach* are, the under surface of the liver and diaphragm. Its pale color, its extent, and the arrangement of the gastro-epiploic vessels are characteristic.

*Gastrostomy.*—This name is applied to opening the stomach through the external surface and establishing a permanent fistula to it.

All antiseptic precautions are taken, and anæsthesia induced by chloroform, as ether is more liable to cause vomiting.

Place the patient on the back and make an oblique incision, about two and one half inches in length, from left to right, parallel with and one inch below the lower border of the cartilage of the eighth rib, terminating opposite to the ninth (Fig. 500, 1). The tissues composing the walls corresponding to this site are divided successively in a director, down to the peritoneum. All bleeding points must now be closed and the peritoneum opened, and its divided

borders caught and drawn outward with forceps, or serres-fines, or small pliers which are permitted to lie on the external surface, to prevent its retraction when the lower border or the left lobe of the liver will be seen. The thumb and

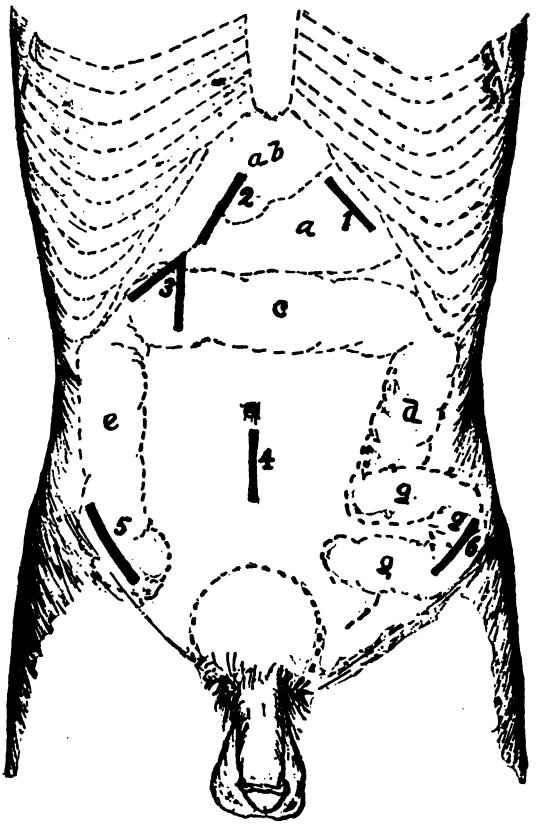


FIG. 500.

*a*, *b*. Left lobe of the liver. *a*. Cardiac end of the stomach. *c*. Ascending colon. *e*. Descending colon. *g*, *g*, *g*. Sigmoid flexure.

fore-finger of the left hand are then introduced, and guided by the under surface of the liver, readily grasp the stomach. If possible, a portion of it should be brought through the opening, or, guided by the thumb and finger, forceps may

be introduced and its anterior surface grasped and drawn through. It is very important at this time to be sure that the portion drawn through be not the colon or some other tissue; its dense white appearance and the arrangement of its superficial vessels and size should serve to distinguish it from any other viscus. Often, as soon as the peritoneum is divided, the entrance of air into the abdominal cavity causes the stomach to retire upward and backward, thereby interposing an annoying obstacle to grasping it. To obviate this difficulty it has been recommended to pump air into the stomach through a tube carried down to the obstruction, or cause the entrance of carbonic acid gas, produced by chemical action at the time; also the fumes of ether conveyed by means of a tube.

These expedients are, however, hardly of sufficient practical importance to merit the trouble incident to their utilization. As soon as the surgeon is satisfied that the stomach is within his grasp, it should be drawn into the opening and fixed, by passing through it in opposite directions two long stiff needles (Fig. 500*a*), allowing their extremities to rest upon the external surface of the abdomen. The parietal layer of peritoneum previously grasped and drawn outward should now be carefully stitched with carbolized silk or catgut sutures to the visceral layer of the stomach, being careful to not carry them into the stomach cavity. Still further security should now be given to the opposed surfaces by carrying four or five stitches of strong carbolized silk through the whole thickness of the abdominal walls, and also through the serous and muscular walls of the stomach. Two other stitches may be introduced, so as to transfix the end of the wound only, care being taken not to include peritoneum. Finally a stitch is passed through the serous and muscular walls of the centre of the exposed portion of the stomach, and left hanging to be used as a future guide to the opening of the organ in case the condition of the patient will admit of a delay, four or five days, sufficient to permit adhesive union to take place between the serous surfaces. If not, then the operation should be completed at once; which is done by making a vertical incision about a half an inch in length through its coats into the

FIG. 500*a*.

cavity, being careful to prevent escape of its contents, or, their contact with the raw surfaces. The wound in the abdominal cavity is now reduced in size by stitches carried through its entire thickness, to correspond to that in the stomach. The lips of the opening into the stomach are then united to those of the abdominal opening, by carbolized silk carried through the entire thickness of both, being careful to oppose the mucous lining of the stomach to the integument of the abdomen.

*Fallacies.*—The colon may be mistaken for the stomach. The difference in color, extent, and muscular arrangement should, together with the difference in mobility, and the fixed relation of the stomach to the under surface of the liver, easily determine the difference between the two. Confusion may arise in distinguishing the costal cartilage of the eighth rib from the contiguous ones. The seventh articulates with the sternum, the first one below it will therefore be the eighth.

Other external incisions differently located and variously shaped are employed; as, a curvilinear one with the convexity toward the median line, extending from the seventh intercostal downward and outward for nearly four inches; one through the left semilunaris; one along the outer side of the rectus, etc. That which has been described in detail, from an anatomical basis, seems the most favorable.

*The results*, however, are of necessity very unfavorable, since the conditions calling for the measure are often of themselves speedily fatal; moreover the delay in resorting to it often renders the patient unable to withstand the shock of the procedure. When due to malignant disease it only acts as a palliative measure; over 60 per cent recovered when done for non-malignant cicatricial obstructions.

*Resection of the Pylorus.*—This operation has been employed during the past two or three years to relieve the obstruction occurring at the pyloris, due to malignant disease and stenosis from other causes. While its inception and performance are in keeping with the rapid strides made in abdominal surgery in the past few years, the nature of the operation and the causes for which it is done must of necessity insure a large number of deaths. The pyloris is in the epigastric region, between the median line and one falling from the tip of the cartilage of the eighth rib to the middle of Poupart's ligament, and is in contact with the under surface of the right lobe of the liver.

The duodenum, which is the next most important factor, is located in the right hypochondriac region, being, of course, a direct connection of the pyloric extremity of the stomach. The normal relations, however, will avail but little in connection with the abnormal size, and the displacement attendant upon an already overdistended stomach. All primary incisions must therefore be located so as to meet the indications of the case in question. The difference in the outlines of the stomach should be noted, both in its distended and empty condition, to better enable the surgeon to properly locate the abdominal incision. In some cases the greater curvature will reach the symphysis pubis.

The patient is prepared for the operation by washing the stomach daily with salicylated water or any suitable antiseptic for four or five days prior to the operation, the stomach pump, or syphon, being employed for the purpose. The intestinal canal should be evacuated the day before the operation. An anæsthetic is given, chloroform being preferable as less liable to produce vomiting, and the patient placed on the back in a good light. The stomach should be thoroughly washed out before beginning the operation.

An incision is made in the median line as nearly as possible over the pyloris about four inches in length. The tissues are divided in the usual manner down to the peritoneum, and all bleeding stopped before this membrane is divided; also, an exploration should be made with the finger, to determine if possible, the exact location of the indurated portion, after which the final opening is made to correspond with it.

If it be impossible to satisfactorily outline the organ, it should be distended with fluid, which must be withdrawn when the location of the diseased portion is determined. The peritoneum is cut, and the pyloris and such other portions as are necessary are then drawn through the wound and all large vessels running in the course of the proposed incision of the pylorus tied by two ligatures and the vessels divided between them. A large, flat, soft carbolized sponge, warmed, is then passed beneath the part to be removed to prevent the entrance of blood and other fluids into the abdominal cavity. Strong ligatures should then be passed through the walls of the viscus at three or four points outside of the proposed incision, to raise the walls of that extremity as soon as it is divided, that its contents will not escape. If any oozing occurs from the cut surfaces they

should be seized by the T-shaped pincers, serresfines, etc. (Fig. 508). The extent of the incisions, as well as their shape, will be governed by the diseased tissue to be removed. The outline of the pyloric cut will be greater than the remaining duodenum (Fig. 509). The calibre of the larger portion should be reduced to a suitable size to be joined to

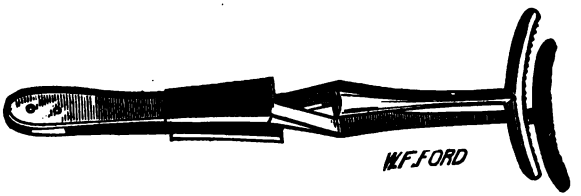


FIG. 508.

its fellow; the Gely suture answers admirably for the purpose, or the openings are joined by aid of the Jobert, or Lambert form of suture, using for the purpose carbolized catgut, or antiseptic silk. After all bleeding is stopped and the peritoneal cavity cleaned, the parts are returned and the abdominal wound closed in the usual manner.

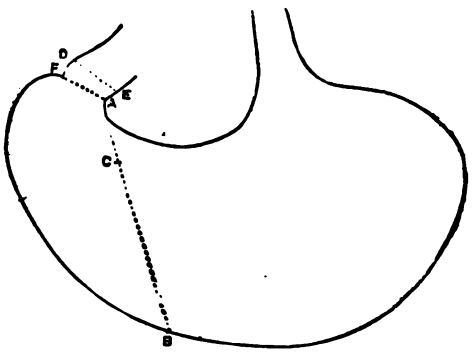


FIG. 509.

The patient should then be quieted by anodynes and nourished by the bowel during the first three or four days until fluid food can be given by the mouth.

*Loreto's operation* is divulsion of the pylorus by the fingers. In this the abdominal incision is made to correspond to the location of the disease as in the preceding; or if the

condition will permit it is commenced an inch and a half below the ensiform cartilage and carried obliquely downward and outward for four or five inches to within an inch and a half of the ninth costal cartilage (Fig. 500, 2). The abdominal incision is made with the same precautions as in the preceding; the pyloric extremity is drawn out and an opening made into it between and at equal distances from its two curvatures, about two and a half inches in length, beginning an inch and a half from the location of the pyloric valve. The hemorrhage is then controlled; the index finger is introduced and carefully rotated, with pressure and counter-pressure through the pyloric valve. The second finger should then be introduced beside the former in the same cautious manner, and so on until the constricted portion is well distended. The wound in the stomach is then closed by the Gely suture, parts returned and the abdominal wound closed as before. The results of this operation are much more favorable than those of excision; and, it is entirely proper that dilatation should be considered in connection with it, the incision through the abdominal walls being made with a view of excising if it be malignant, and divulsing if the stenosis be due to non-malignant causes.

## OPERATIONS ON THE GALL BLADDER.

It occasionally happens that obstructions of the cystic duct and distention of the gall bladder from gall stones or other causes give rise to a tumor of considerable size, which is dangerous on account of the liability to rupture, and is distressing from pain and tenderness.

*Cholecystotomy.*—This consists in cutting down upon the tumor through the abdominal walls to the peritoneum; when after all bleeding has ceased, the peritoneum is divided, if it be adherent to the serous covering of the tumor; if not adherent, and the condition of the patient will permit, the wound should be filled with strips of lint soaked in carbolic acid solution in oil, or with marine lint. At the expiration of five or six days the adhesion will be sufficiently firm to admit of cutting through the tissues into the distended sack. The cut should be made in the

centre of the long axis of the exposed portion; its borders grasped at once and raised upward to prevent the fluid from coming in contact with the raw surfaces. If the tumor be tense it will lessen the danger if the sack be aspirated prior to opening it. After its contents are removed, the edges of the gall bladder are united to a sufficient portion of the abdominal wound to constitute a small fistulous opening, and its remaining portion is closed. The results of the operation are more favorable than the results of the condition calling for it.

*Cholecystectomy*, or extirpation of the gall bladder, is employed instead of cholecystotomy when by reason of the presence of a biliary abdominal fistula, malignant disease or tumors of the gall bladder the latter is rendered useless. If the opening through the abdominal walls be the same as in cholecystectomy, and the case is better adapted to cholecystectomy, the incision will then require to be extended upward sufficiently to command the neck of the sack. If, however, the latter operation be contemplated in the beginning, the abdominal incision is to be made in the right hypochondrium, parallel to the lower border of the liver, and joined by a second incision running along the outer border of the right rectus muscle (Fig. 500, 3). The abdominal cavity is then to be opened, the transverse colon and small intestines pushed down by a large sponge, and liver elevated, so as to bring the hepatic duodenal ligament into prominence. The gall-bladder is easily separated from the liver, the cystic duct exposed and ligatured in two places with carbolized silk, and the duct severed between them. The abdominal wound is closed as in the preceding operation.

This operation, like the ones preceding it, should be done with full antiseptic precautions.

*Laparotomy, or Abdominal Section.*—This operation is employed to overcome the intestinal obstructions due to various causes, such as invagination, adhesions, malignant disease, etc. The opening can be made over the seat of the obstruction; but it is better to make it in the median line below the umbilicus (Fig. 500, 4). The opening should be a free one, and made continuously to avoid the entrance of blood. Its size should be sufficient to admit of the easy introduction of the hand. If any difficulty be experienced in locating the seat of the trouble, or overcoming it, the opening should be still further enlarged. Care must be taken

to not tear or injure the intestine. It is better, if the obstruction does not yield readily, to raise that portion out of the opening, place it, along with such intestines as may escape, upon the Lister gauze, saturated in warm antiseptic solution, or large flat sponges treated in the same manner. The intestines that are not being handled should be treated in the same manner. As soon as the parts are restored to their normal position the intestines are returned, the abdominal cavity cleansed, and the external wound closed.

The rate of mortality in all cases is 68 per cent., which is too great to recommend its employment upon children under one year of age. In adults the prognosis would be much better were it not that the diagnosis is uncertain until the condition of the patient almost precludes a successful operation.

*Enterotomy* consists in opening the abdominal walls and securing the intestine above the point of obstruction, and when it is low down, attaching it to the abdominal walls, thereby establishing a fecal fistula.

It can likewise be done in laparotomy when the gut is gangrenous or otherwise unfit to be returned.

The operation is located in the right iliac fossa, since the intestines above the obstruction lie principally at this situation. The intestines above the obstruction are filled; those below are empty; consequently the selection of the proper one to open becomes easy.

In "right inguinal enterotomy," as this operation is sometimes called, an incision is made an inch above Poupart's ligament and parallel with it, beginning at the anterior superior spine of the ilium and ending opposite the internal abdominal ring (Fig. 500, 5). The layers of the abdomen are divided consecutively on a director, down to the peritoneum, which is opened, after all hemorrhage has ceased, for one and one half inches. The first intestinal loop presented is drawn through, provided it be not an empty one; a long thread is passed through it and looped, and the intestine again returned and kept from the opening by a small-sized carbolized sponge, to which is attached a string, which is forced through the opening and allowed to remain while the peritoneum is being drawn outward and stitched to the integument. The sponge is then removed, and the intestine pulled out by the looped ligature which has remained upon the abdominal wall. The coats of the

intestine are carefully united to the walls of the opening by a deep row of interrupted carbolized silk sutures passed in the transverse axis of the gut, through its serous and muscular coats, being entered two or three lines from the integumentary border of the wound, and after including the gut, returned through the border from below upward, and tied about one fourth of an inch from the point of starting. The serous surfaces being accurately apposed by the deep row of stitches, the intestine is raised to a level with the surface of the abdomen, and the space between it and the border of the abdominal wound packed with absorbent cotton or lint saturated with carbolic acid and oil for the purpose of protecting their surfaces from contact with any of the intestinal contents; open the gut longitudinally for one inch, catching the edges as fast as cut with pinchers. After the contents are evacuated, a small sponge with a string attached should be pressed into the opening in the gut to restrain any further escape while its borders are being carefully sewed to the integumentary border by the continuous or interrupted suture.

The results of this operation are superior to those of laparotomy, but the patient is subject to the annoyance of a fecal fistula. If the obstruction be due to a foreign body in the gut, and it be located, the intestine can be incised, obstruction removed, wound of the intestine closed by the Gely or other suture, the gut returned, and the abdominal incision closed.

*Enterectomy* consists in removing a segment of the intestine and uniting the divided extremities.

*Colectomy* is the performance of a similar operation on the large intestine, both of which have been successfully done. They are particularly useful when the obstruction arises from a cancerous growth. In fact, it offers the only opportunity of ridding the patient of it. The precautions already enjoined in connection with other operations of the abdominal cavity must be strictly enforced in these.

## COLOTOMY.

Colotomy can be performed in three situations, two of which are located posteriorly in the right and left lumbar

regions, and the third in the inguinal region of the left side. The operation is performed for the relief of contractions of the intestines below the point of opening, due to morbid growths of all kinds which are not amenable to other forms of treatment. It is also done to relieve fistulous communications existing between the bowels and bladder; and elsewhere, when its annoyance exceeds that from an artificial anus.

*Left Lumbar Colotomy.*—In this instance the descending colon is opened between the crest of the ilium and the last rib.

*Linear Guide to the Operation* (Fig. 510).—Draw a line which shall connect the anterior and posterior superior spinous processes of the ilium; draw a second line perpendicular to this, one inch posteriorly to its centre. This line marks the course of the colon. Draw a third line four inches in length, its centre corresponding to the perpendicular one, obliquely downward and outward, parallel with the lower border of the last rib. The third line marks the course of the incision, half of which is behind the perpendicular line.

FIG. 510.

*Muscular Guides.*—The outer border of the erector spinæ, also the outer border and anterior surface of the quadratus lumborum.

*Contiguous Anatomy.*—The colon at this situation is covered by peritoneum at its anterior surface and sides; its posterior surface is not covered by this membrane. If the gut be collapsed it retreats towards the median line, behind the quadratus lumborum, and is followed by its peritoneal covering. The collapsed state therefore exposes the peritoneum to greater danger of being injured. When distended it presses its peritoneum outward, and can be readily seen projecting beyond the outer border of the quadratus lumborum. The surfaces not covered by peritoneum are surrounded by areolar tissue, which connects it to the left crus of the diaphragm, the left kidney and anterior surface of the quadratus lumborum anteriorly; and externally it is in contact with the small intestines. The left kidney is situated posteriorily to it, and its lower extremity can be easily felt at the upper border of the wound. The vessels lying in the course of the incision are the abdominal branches of the lumbar vessels. The ilio-hypogastric and

ilio-inguinal nerves likewise cross in front of the quadratus lumborum at this situation.

The colon is recognized by its greenish color, its longitudinal bands, which are three in number—one anteriorly, which is covered by peritoneum, a second corresponding to its attachment, the third or lateral at its inner side. It is not quiet during respiration, although it does not move up-

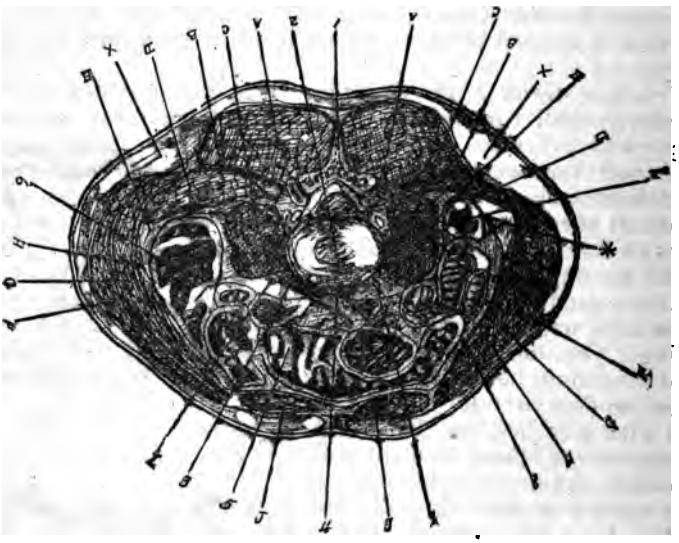

FIG. 511.

A, A. Erector spinæ. B, B. Quadratus lumborum. C, C. Psoas magnus. E, E. Fatty connective tissue. F, F. External oblique. G, G. Internal oblique. H, H. Transversalis. I, I. Ureters. J, J. Abdominalis. 1. Spinous process. IV. Lumbar vertebra. 2. Intervertebral substance. 3. Vena cava inferior. 4. Aorta descendens. 5. Transverse colon. 6. Ascending colon. 7. Descending colon. 8. Great omentum. * Peritoneum reflected over the outer and anterior surface of descending colon. 2. With layer of subcutaneous fat, including the latissimus dorsi.

ward and downward as the small intestines are sure to do. It cannot be raised, while the small intestines can. Finally, if it be filled with air after the fascia lumborum is divided and the fat pushed aside, it will become distended quickly and assume a proportionately greater size than the small intestines.

If the conditions will permit, the bowel should be thoroughly washed out before the operation is begun; *after which* the patient is etherized and placed on the *right side, with* a hard pillow under the loin that the left

side may be made more prominent. The incision is then made in the course of the line already marked out, and carried through the integument, fascia, and thick layer of fat usually found at this situation, down to and through the latissimus dorsi muscle and the posterior fibres of the external oblique, the internal oblique, and transversalis, which are divided upon a director, bringing the outer portion of the quadratus lumborum into view (Fig. 511) enclosed within its compartment of the lumbar aponeurosis, which extends outward to become continuous with the transversalis muscle. This is carefully divided upon a director, and the fascia transversalis that lies beneath it is divided in a similar manner, which brings into view the fatty areolar tissue which connects the gut to the quadratus lumborum and the left crus of the diaphragm. The fat is pushed aside by the finger and handle of the scalpel, and the bowel distended with air, when its situation will become positive. Confirm its identity by the means given above before proceeding further. As soon as the gut is distended it will appear at the opening, and, perhaps, even rise above its level; roll it outward with the finger from beneath the quadratus, cutting the outer border of the muscle, if necessary, so as to present its posterior aspect to view, which is known by the longitudinal band; seize it with a tenaculum or forceps, and hold it upward while a stout, curved needle, armed with a well-carbolized silk ligature, is passed deeply through the skin at one side of the perpendicular line, about four lines from the border, into and transversely through the intestine to emerge on the other side of the line at a similar distance from the border of the wound; this suture is drawn through, and each end given to an assistant. The needle is then passed in a similar manner at the opposite extremity of the incision, and these ends also given to an assistant (Fig. 512). All the space between the walls of the gut and borders of the wound is then packed with *lint saturated* with acid and oil. The gut is

FIG. 512.

then opened by a longitudinal or oblique incision, about two inches long (Fig. 513). The liability to a subsequent protrusion of the mucous membrane and of injury to the peritoneum at the time is less with a longitudinal than with a

FIG. 513.

FIG. 514.

transverse one. After the contents of the bowel are evacuated, a sponge, with a string attached, should be pressed into the opening to retain any remaining discharge until the edges of the gut have been stitched to the borders of the wound. The finger or hook should now be inserted into the bowel, and the loops of the ligature just passed be caught, drawn out (Fig. 513), and cut off, when each one will become two distinct sutures which, after the oiled lint has been removed and the wound cleansed, can be tied (Fig. 514). The remaining portion of the gut wound is then stitched (Fig. 515), carbolized pad bound over the opening which, together with the sponge, must soon be removed to allow the escape of fecal matter.

FIG. 515.

The rate of mortality from this operation is about thirty-eight per cent.

*Right Lumbar Colotomy.*—In this the incision is made at the right side. It is in all respects governed, however, by *the same rules* as the preceding. The caput coli is the

point attacked, and owing to its size, can be more readily distinguished.

The results are much less favorable, owing partly to the loss of the function of the colon, and also to the more objectionable location of the disease compelling the operation in this situation.

*Left Inguinal Colotomy* (Littre).—This method consists in opening into the sigmoid flexure of the colon by an incision through the abdominal walls, including the peritoneum in the left iliac fossa.

*Linear Guide to the Operation.*—Draw a line two inches in length in the left iliac fossa, commencing about an inch above and internally to the anterior superior spine of the ilium, and continue it downward parallel with Poupart's ligament. The patient is placed upon the back, and an opening made to correspond to the line given above. All hemorrhage is stopped before the peritoneum is opened. As soon as the peritoneum is cut, insert a sponge connected with a string, which will prevent the escape of the intestines; stitch the peritoneum to the integumentary border; withdraw the sponge, and draw out the intestine which is located directly under the opening, and can be recognized by the peculiar shaped fatty fringe attached to it. It is stitched to the external wound in the same manner as in the lumbar region. The treatment is the same in other respects. This is not as safe an operation as that in the lumbar region, as the peritoneum is directly involved.

FIG. 515a.

The rate of mortality is ten per cent greater.

*Abscess in the Right Iliac Fossa.*—It may be superficial or deeply seated. If the former, it can be opened with a knife.

If deeply seated, aspiration should be done to detect the earliest formation of pus. If the swelling be well marked and pus is found, make an incision four or six inches in length, commencing an inch internal to and above the anterior superior spinous process of the ilium, extending it downward parallel with Poupart's ligament; divide the various layers of the abdominal wall cautiously on a direc-

tor; when the abscess wall is reached, insert an aspirating needle as a precautionary measure, and, if pus be found, open the cavity freely; wash it thoroughly, insert a drainage tube, and allow it to heal from the bottom. If pus be not present, allow the wound to remain open, when, if it forms, its discharge will take place readily.

*Artificial Anus, or Fecal Fistula.*—When the distal extremity of the bowel is pervious and the fistula has served its purpose, it should be closed. If the septum be shallow and yielding, it can be forced back by means of a sponge pressed against it and confined in position; wooden plugs and lint are employed in a similar manner; failing in this, the septum should be grasped by a clamp or enterotome (Fig. 515*a*) passed into the opening on either side of the septum, and the blades firmly screwed together. In a few days the constricted portion sloughs, and the instrument comes away. The external opening usually closes; if not a plastic operation may become necessary.

## OPERATIONS ON THE KIDNEY.

*Nephrotomy.*—This consists in opening into the kidney through an incision in the lumbar region. The operation should be preceded by the introduction of an aspirating needle both to locate and define the nature of the tumor.

The patient is placed in the same position as in lumbar colotomy. The incision is made in the same direction; its location is often similar, although, made nearer to the last rib than in colotomy. The same precautions preparatory to and attending the operation are required, the tissues resting upon the tumor are divided in the same manner. When the sac is reached it should be aspirated to confirm the diagnosis. An opening is then made into it, the contents evacuated, and the cavity washed out with a solution of the bichloride of mercury, 1 part to 2000 of water. Carbolic poisoning seems more liable to occur from its use in this situation than elsewhere.

Remove all calculi that may be found, and unite the edges of the kidney to the wound, and it is allowed to heal by granulation; or a drainage tube is inserted and the external opening closed by deep sutures, and antiseptic dressing.

If the kidney structure be destroyed, or the seat of malignant disease, it is then wise to remove the entire organ. The results are best when done for pelvic calculi without pyonephrosis, and in hydro-nephrosis and movable kidney. The death rate is about 20 per cent.

*Nephrectomy.*—This operation consists in removing the kidney in part, or entirely, from the body. The removal is indicated in cases of a wound, painful floating kidney, cysts, hydro-nephrosis, pyelitis, with, or without calculi; neoplasm, urinary fistula from communication with the ureter. Before the operation is done, the other kidney should be ascertained to be present, and in a healthy condition.

The primary incision may be made in the loin, or, through the abdominal walls; which is the better one, is a matter as yet unsettled. The character of the case will have much to do in determining this point. If the tumor be movable, malignant, of large size and adherent, or, if it be suspected that the disease be bilateral, the abdominal incision is preferred; since it admits of the examination of the other kidney.

The rate of mortality, however, is in favor of the lumbar incision.

*Lumbar nephrectomy* is to be done with all possible antiseptic precaution. The initiatory incision is made in the same situation and direction as in nephrotomy. If the space will permit, the tumor is isolated, and its pedicle tied *en masse*, or, which is better, the vessels are secured separately. The ureter must always be tied and the lower extremity brought through the external opening. It often happens that the size of the tumor and its adhesions to surrounding tissues, require the opening to be enlarged; this can be done by extending it towards the spine as well as in the opposite direction. If this be inadequate when taken in conjunction with the additional space to be gained by pushing upward the last rib, this bone can be resected subperiosteally for three or four inches, which will be found to afford quite sufficient room.

After the removal of the tumor, the wound should be thoroughly disinfected with a solution of carbolic acid or other suitable substance; ureter secured externally, and the opening closed by deep sutures, and dressed antiseptically.

*Abdominal Nephrectomy.*—The opening through the abdominal walls can be made in three situations. 1. The

most frequent, is through the linea alba; 2, at the outer side of the rectus (linea semilunares); 3, in the inguinal region. The first two require that the peritoneum be divided; the last admits of a subperitoneal removal, but can scarcely be employed except in well marked cases of movable kidney. In either instance the abdominal opening is made in the usual cautious manner, about six or eight inches in length, and larger if the size of the tumor demands it. The hand is introduced, tumor located and outlined, and the condition of the other kidney noted. The diseased organ is then enucleated and raised through the opening, its vessels and the ureter tied separately with strong carbolized ligatures, cut short, and returned. The abdominal cavity is then cleansed of all foreign matter, and the walls united and dressed antiseptically. If the ureter is to be returned into the cavity of the abdomen, its extremity should be thoroughly antisepticised with the carbolic acid, or the bichloride of mercury solutions. It is considered better, however, to attach it to the abdominal opening. It is recommended to tie the vessels of the pedicle before commencing the enucleation, thus lessening the danger of hemorrhage. The advantages of opening outside of the rectus are said to be, less hemorrhage from the abdominal walls, than when the opening is made through the linea alba; it brings the surgeon more directly on the tumor and its pedicle. If the space from which the tumor has been removed be a large one and accompanied by a strong tendency to oozing from the surface, the perforated glass drainage tube should be introduced, carried directly to the bottom, and allowed to protrude through the abdominal incision. The fluid which accumulates in it can be removed by carbolized sponges under the antiseptic spray.

It is impossible to lay down other than the general means of procedure in the operation, since the conditions surrounding the individual cases, often call for the exercise of other than stereotyped rules.

The rate of mortality in nephrectomy is about 44 per cent; being about 10 per cent greater in abdominal, than in the lumbar operation.

*Nephro-lithotomy*, or renal lithotomy, is the exploration of the pelvis of the kidney with a long needle, to ascertain the presence of calculi within it. If present they are removed with forceps, through an incision made into the kidney. The external opening is made similar to that for

lumbar nephrotomy; the kidney is exposed, calculus detected, incision made through the cortex into the pelvis in the long axis of the kidney of sufficient size to remove it with suitable forceps, and the opening closed. The hemorrhage resulting from the division of the kidney structure is quite severe, but is quickly controlled by pressure. The wound in the kidney usually heals readily; sometimes urine will escape through it for ten or twelve days. With a view to cause union of its structure, the lips of the kidney wound have been united by fine catgut sutures with favorable results. The external wound is suitably drained, closed, dressed antiseptically, and the patient given demulcent drinks.

All of the cases reported (6) of this operation have terminated favorably.

*Fixation of a Movable Kidney.*—To accomplish this purpose in cases where all ordinary means have failed, an incision is made from a little below the lower rib to the crest of the ilium, along the outer border of the erector spinæ, down to the quadratus lumborum. Substantially the same tissues are divided in the vertical as in the oblique incision of nephrotomy. There is a greater danger of hemorrhage, however, as the vertical incision is made at nearly right angles to the lumbar vessels. As soon as the fascia lumborum is divided, the kidney should be pushed into the wound, the fascia transversalis slit up, the fatty capsule surrounding the kidney opened longitudinally and its borders stitched to the deep structures of the wound with eight or ten catgut, or carbolized silk sutures. The wound is then stuffed with carbolized gauze and allowed to heal from the bottom; the patient remaining in the dorsal position until the healing is well completed; after which, any of the various forms of pads or other retentive apparatus may be applied to retain it, until the adhesions are thoroughly established.

The subsequent giving away of the fixation point under the influence of movement, suggests the practicability of continuing to wear some form of retentive apparatus.

*Splenectomy*, which consists in the removal of the spleen, has been done between thirty-five and forty times. It has not proven successful, however, in any instance when done for leucocythemia; when done for displacement or simple hypertrophy the results are flattering, being in excess of fifty per cent. The incision is made in the median line,

about eight inches in length, its centre corresponding to the umbilicus; the peritoneal cavity is opened in the usual manner, the omentum and intestines displaced, and the tumor carefully raised through the opening; after which the vessels at the hilum are clamped and tied, and also those of the gastro-splenic omentum, which should be divided into several sections by transfixion. All hemorrhage is stopped, and the abdominal wound closed either with or without a

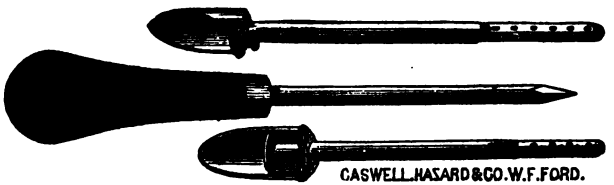


FIG. 516.

drainage tube, depending on the amount of prospective oozing.

The spleen must be handled very carefully during the removal, or it may be ruptured.

*Paracentesis Abdominis.*—This is an operation employed to remove fluids from the abdominal cavity. An anæsthetic is not an essential. The bladder and rectum should be emptied and the abdomen carefully percussed to deter-

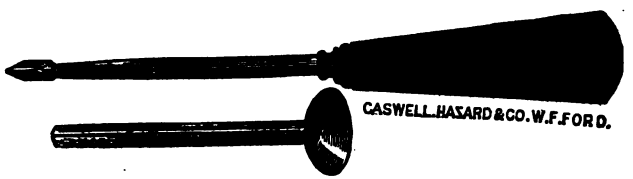


FIG. 517.

mine the limit of dullness. The belly is then surrounded by a broad bandage, many-tailed at either extremity, with a small opening in the centre corresponding to the point of proposed puncture. If unable to sit, the patient is placed upon the side near to the edge of the bed. If his strength will permit, he can be placed in the ordinary chair, body bent forward, and the head and arms resting upon the back of another in front.

The instruments necessary are the scalpel, and the trocar, Fig. 516 being an admirable example of the latter. Fig. 517 represents the ordinary one, which will meet all ordinary indications.

The aspirator (Fig. 518), devised by Tieman & Co., is cheap, durable, and efficient. Fig. 519, the handy aspira-

Fig. 518.

tor of Fitch is not expensive, and can be used in conjunction with the canula figured above. In either instance the calibre should be small enough to admit of the gradual discharge of the fluid, for if it be done too rapidly the danger of syncope is imminent. If the canula be sharp it can be introduced without the aid of the scalpel, after

having determined the presence of the fluid beyond a doubt, by aid of the hypodermic syringe. The instrument is seized with the index finger resting on its upper surface

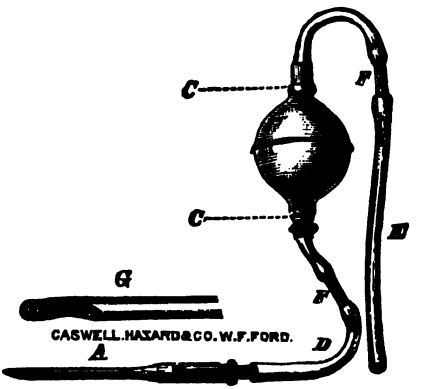


FIG. 519.

(Fig. 220) to limit the extent of its introduction, and is plunged quickly through the walls of the abdomen in the median line, midway between the umbilicus and pubes, and the trocar withdrawn. As the fluid escapes the bandage

FIG. 520.

is tightened to facilitate the flow, as well as to support the patient. The flow is continued until the fluid is removed, unless the patient is threatened with syncope.

When the trocar is withdrawn, the puncture should be closed by a strip of adhesive plaster, or, better, by a hare-lip pin confined in the usual manner; the tails of the compressing bandages are then tied firmly to maintain the pressure. Care should be taken that no air be permitted to enter the cavity.

*Fallacies.*—A distended uterus or bladder, a displaced or enlarged liver may be punctured.

If the canula be sharp-pointed, the intestines may be injured during the withdrawal of the liquid. A vessel of the abdominal walls may be injured by its introduction. If the uterus be distended from any cause, the puncture can be made through the right or left semilunaris or above the limit of the distention.

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## OPERATIONS APPLICABLE TO THE VARIOUS CONDITIONS OF ABDOMINAL HERNIA.

The conditions of hernia in the various situations which are amenable to operative procedure, are for the reducible, the operation for a radical cure; for the strangulated, taxis and division of the constriction; for the simple, irreducible and incarcerated, the liberation of their contents and their return to the proper situation.

*A hernia* may be defined to be the protrusion of a portion of the contents of the abdomen through any opening in its walls. Each protrusion is composed of a sac and its contents, surrounded by the tissues composing its individual walls. With but few exceptions all herniæ possess a sac, which is in every instance composed of the parietal peritoneum (Fig. 521); only those viscera which are not surrounded by this membrane can form a hernia without a sac; such as the caput coli, colon, bladder, pancreas, etc. The contents of a hernial sac, in the ordinary sense of the term, will then consist of the small intestine and omentum, either singly or conjointly (Fig. 522). If the larger viscera escape, it will be exceptional, and probably depend upon an abdominal wound, which is called a protrusion of this or that organ rather than a hernia of the same. The normal appearance of the omentum and small intestine should be given a careful study, that the operator may be able to

determine the various degrees of change in their appearance when subjected to the different influences associated with hernial protrusions. The granular appearance of the omental fat, together with its pale color and extra fibrous structure, will distinguish it from the subserous tissue fat. The omentum and gut, while in the sac, usually bear the same comparative relation to each other as in the abdominal cavity; the former being in front. The sac has a neck and a body; the shape and size of the latter depends upon the amount and density of the surrounding tissues and the nature and compactness of its contents. The neck is its constricted portion, and corresponds to the opening through which it escaped; its size is governed by the density of the tissues by which it is surrounded, the age of the protrusion, degree of traction, and compressibility of its contents. A knowledge of the normal characteristics of the

FIG. 521.

FIG. 522.

peritoneum are as essential to the surgeon as are those of the contents of the sac. Its rough outer and smooth inner surfaces, the arrangement of its vessels and its transparency should be understood. It must not be forgotten, however, that the physical appearance of the sac and its contents become changed when long subjected to the vicissitudes attending hernial protrusions.

The tissues composing the walls of the protrusion, or the "coverings of hernia," vary according to its situation, rapidity of development and size. While they may readily be distinguished in their proper places as component parts of the abdominal wall; yet, when stretched around the body of a hernia and more or less changed from the effects of pressure and extraneous influences, their individuality often becomes difficult of discernment.

In a recent hernia the cellular tissues and fat will vary but little from the normal conditions; if it be old, these tissues will be much thinner than usual. In a recent protrusion, the muscular fibres of the cremaster will be exceedingly sparce and illy developed, while in the older ones, the influence of the coincident traction will lead to their becoming well developed, and of great diagnostic importance, not only as to the depth of the incision, but the variety of the protrusion. The transparent sac often becomes more or less opaque, and so connected with the cellular tissue upon it as to be scarcely distinguishable.

It can be safely said, that the changes in the appearance and the anatomical relations of the component parts of a hernia, including the influences and processes to which it is subjected, can be so manifold that it will present as varied and perplexing problems, requiring a speedy solution, as any morbid condition of the body.

Prior to attempting any form of operation upon a hernia, it is necessary that the surgeon be acquainted with the important blood-vessels and their relation to the body, and more especially the neck of the sac. He must know the bony land-marks, the ligamentous associations and the direction of its exit, else he will be unable to distinguish the variety or to manipulate its return.

## OPERATIONS FOR RADICAL CURE.

### (*Reducible Inguinal.*)

*Heaton's Operation.*—This consists in injecting into the inguinal canal with a syringe constructed for the purpose, ten or fifteen drops of a fluid, composed of Thayer's fluid extract of quercus alba, prepared in vacuo, one half an ounce; solid extract of quercus alba, fourteen grains. Triturate with gentle heat, until the solution is as perfect as possible. A grain of morphia to the ounce can be added, to alleviate the pain caused by the injected fluid.

The patient is placed on the back, contents of the sac returned, and if necessary retained by the finger of an assistant. Locate the external abdominal ring with the right forefinger passed upward and outward, invaginating the scrotum; press the left forefinger perpendicularly upon the integument over the ring, using sufficient force to press the integument together with the finger directly into the ring,

thus leaving nothing between it and the external pillar, but the integument and subjacent fascia. The syringe, already changed, is taken in the right hand, and quickly introduced through the integument and fascia into the inguinal canal, closely hugging the external pillar. The forefinger is then removed, and the needle carried carefully along the posterior surface of the aponeurosis of the external oblique, for an inch or so, when the fluid is deposited, drop by drop, in various portions of the canal, by moving the point around during its withdrawal. A small portion should be deposited at the extreme end of the canal; the intercolumnar fascia, and the pillars of the external ring should be well medicated. The needle is then withdrawn, the opening sealed, compress and bandage applied, and the patient kept

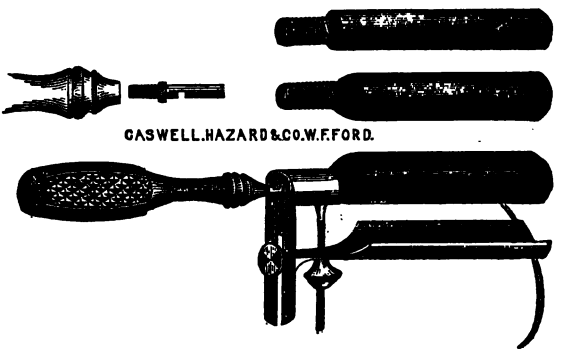



FIG. 523.

in the dorsal position. If undue inflammation occurs, it is to be treated in the usual manner. As a rule the pain and tenderness will disappear in two or three days, after which the patient should be kept quiet for ten days before attempting to walk, and then the part should have proper support which should be continued in use for six or eight weeks, and even longer in the interest of discretion. The results claimed for this method by its originator are not substantiated by trials to which it has been subjected by many careful and unprejudiced surgeons. It is, however, devoid of danger, provided the fluid be not thrown into the peritoneal cavity, and is rarely followed by suppuration. In a recent oblique hernia with a small neck it is a harmless expedient, which often affords relief. It

must not be forgotten, however, that unless constant caution is observed, the protrusion may recur.

The percentage of cures and failures are about the same, 30 per cent. In the remainder the result is indifferent.

*Wurtzer's Method.*—The protruded parts are returned, and a fold of integument is pushed as far as possible into the canal with the index finger of the left hand; the cylindrical portion of the instrument (Fig. 523) is well oiled, and carried into the cul-de-sac guided by the finger which is slowly withdrawn as the instrument is inserted. The distal extremity of the instrument is passed up to the internal ring, the needle projected, passing through the neck of the sac, and tissues of the abdominal wall; the concave cover is then screwed down, and a cork fixed on the end of the needle. The instrument is allowed to remain eight or ten days. After the removal, the patient is kept in bed as much longer, and is then permitted to get up, keeping the parts supported by a truss for five or six months.

FIG. 524.

*Agnew's Modification.*—The integument is invaginated as before, and the instrument (Fig. 524) introduced with its grooved blade resting internally to carry the invaginated integument to the outer extremity of the canal. The blades are then widely separated, and the long needle armed with a silver wire is inserted into one of the grooves of the inner blade, and guided by it, is passed through the superimposed tissues, the end of the wire grasped, needle withdrawn and directed by the other groove through the tissues in the same manner causing the points of puncture to be about a half an inch apart. The wire is then cut of sufficient length to be twisted around a piece of cork or bent, thus securely fastening the apex of the invagination within the canal.

The sides of the inguinal canal are now drawn together by three transverse sutures half an inch apart, introduced by a needle armed with stout silk thread, which is passed between the blades of the instrument, which should then be withdrawn, and patient kept confined to bed.

The transverse sutures are allowed to remain for ten

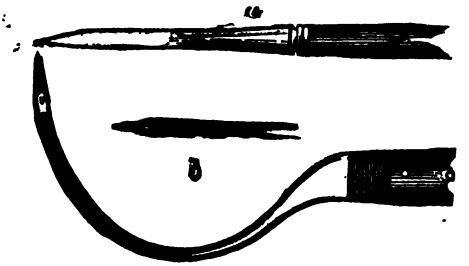


FIG. 525.

days or two weeks, the silver one an indefinite time; the object being to cause a firm agglutination of the invaginated plug to the surrounding tissues.

The results of this operation are flattering, if the cases be correctly reported, over 80 per cent being cured.

*Wood's Method.*—This consists in the drawing together, and retention of the tendinous structures of the inguinal canal and pillars of the ring by the means of a ligature, until the parts become united by effused lymph.

The instruments required are a tenotome, semicircular needle attached to a strong handle and a silver-plated copper wire (Fig. 525).

FIG. 526.

The method of procedure is succinctly portrayed by Mr. Druit: "The patient being tied on his back with the shoulders well raised and the knees bent, the pubes cleanly shaved, the rupture completely reduced, and chloroform administered, an oblique incision about an inch long is made in the skin of the scrotum over the fundus of the hernial sac. The knife is then carried flatwise under the margin of the incision so as to separate the skin from the deep coverings of the sac, to the extent of about an inch or rather more all around. The forefinger is then pressed into the wound and the detached fascia and fundus of the sac invaginated into the canal as represented in Fig. 526.

The finger then feels the border of the internal oblique muscle lifting it forward to the surface. By this means the

FIG. 527.

inner edge of the conjoined tendon is felt at the inner side of the finger. The needle is then carried carefully

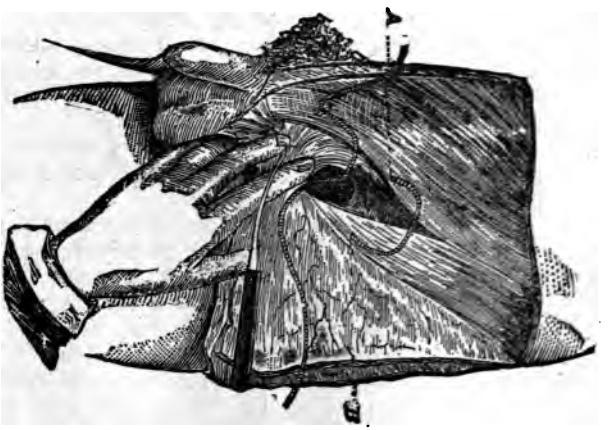


FIG. 528.

up to the point of the finger along its inner side and made to transfix the conjoined tendon and also the inner pillar of the ring (Fig. 527). When the point is seen to

raise the skin the latter is drawn over toward the median line and the needle made to pierce it as far outward as possible.

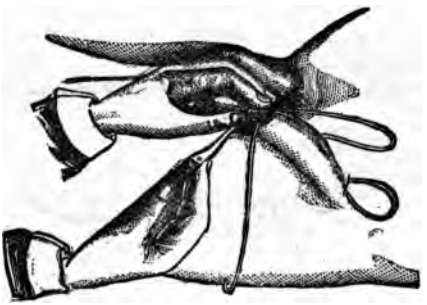


FIG. 529.

A small hook is bent on the point of the wire, inserted into the eye of the needle, and drawn back into the scrotum and detached. The finger is next placed behind the

FIG. 530.

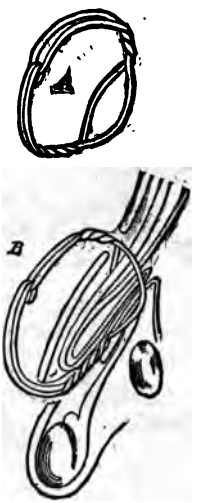



FIG. 531.

outer pillar of the ring and made to raise that and Poupart's ligament as much as possible from the deeper structures. The needle is then passed along the outer side of

the finger and passed through Poupart's ligament a little below the deep hernial opening (Fig. 528). The point is then directed to the same skin puncture before made, the outer end of the wire hooked on to it, drawn back into the scrotal puncture as before, and then detached.

Next the sac at the scrotal incision is pushed up between the thumb and forefinger and the cord slipped back

FIG. 532.

from it, as in taking up varicose veins. The needle is then passed across behind the sac, entering and emerging at the opposite ends of the scrotal incision, as shown in Fig. 529. The end of the inner wire is again hooked on and drawn back across the sac. The needle may be made to pass through one or both of

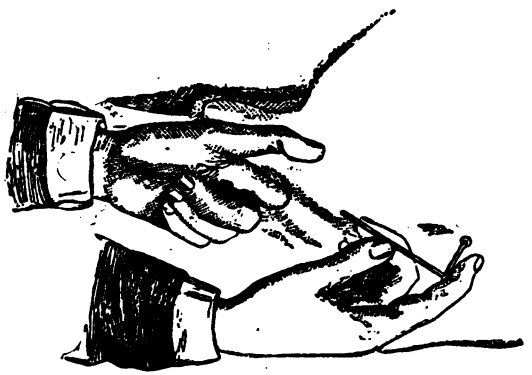


FIG. 533.

the pillars at the same time close to their insertion. Both ends of the wire are then drawn down until the loop is near the surface of the groin above, and are twisted together down into the incision and cut off to a convenient length. Traction is then made on the loop which invaginates the sac and scrotal fascia well up into the ingui-

nal canal. The loop of wire is firmly twisted close down into the upper puncture and bent downward to be joined to the two ends below in a bow or arch beneath which is placed a fine pad of lint (Figs. 530 and 531), and the whole confined in position by a spica bandage.

*Modification with Pins.*—For small hernia and hernia in children Dr. Wood employs a pair of rectangular pins (Fig. 532); with the finger in the inguinal canal, as in the preceding, one is made to pass through the conjoined tendon and the internal pillar from above downward and the other to pass through Poupart's ligament from below upward (Fig. 533).

They should both be caused to enter and emerge at the same point of cutaneous puncture. The pins are bent at a right angle at the blunt extremity, the angle being looped. After the transfixion they are locked to each other and twisted around to more closely entwine the included structures. The ends of the pins are then cut off and the blunt extremities pressed against the abdominal wall and confined in position and allowed to remain eight or ten days (Fig. 534). The results of this method as recorded by Dr. Wood are most excellent, seventy per cent being satisfactory cases; between one and two per cent died.

FIG. 534.

These results have not as yet been duplicated by other operators.

*Direct Method.*—This consists in cutting down upon the part and refreshing the edges of the opening as in hare-lip, and sewing these together.

If the opening be large this method will not effect a cure.

*Czerney's Method.*—Expose the sac by a free incision in its long axis and separate it from the surrounding tissues, isolate its neck and tie it with a strong catgut ligature. Amputate the sac below the ligatured point, push the stump into the abdominal cavity, refresh

the borders of the opening, and unite them by a continuous catgut ligature.

Of the cures reported all but one resulted in a satisfactory manner. It is suggested by Prof. S. D. Gross that the method can be modified by simply tying the sac as before and returning it to the abdominal cavity, which will expose the patient to no unnecessary danger. In all cases of so-called radical cures from whatsoever method, the fondest anticipations of the patient and surgeon are too often dis-

FIG. 535.

pelled by the return of the protrusion. The direct methods can be employed in the treatment of all forms where the neck of the sac can be gotten at and the borders of the opening approximated.

*Radical Cure of Femoral Hernia* (Wood).—The same instruments are required in this as in the inguinal region. Patient is placed on the back with shoulders well elevated, an incision an inch in length is made in the long axis of the protrusion through the integument. The subjacent fascia

is separated from the integument and is pushed into the femoral opening by the index finger, which is placed at the inner side of the femoral vein to protect it. The needle is passed upward through the sac, directed so as to include as well the pubic portion of the fascia lata over the pectineus muscle (Fig. 535, B), the point appearing at the wound, and then pushed upward and through Poupart's ligament at the nail of the invaginating finger. Tke skin of the groin is drawn outward and pierced by the needle into which the

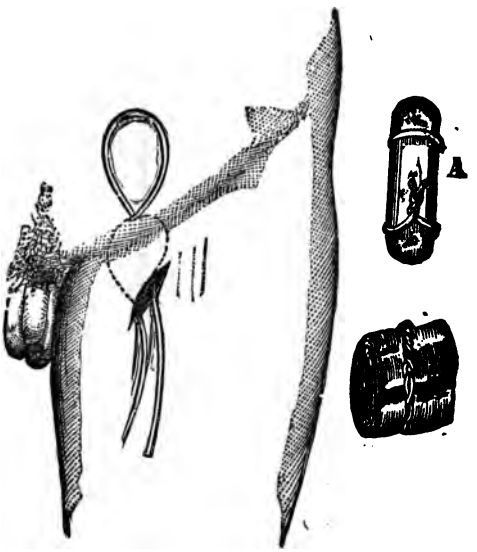



FIG. 536.

wire is introduced and carried downward by the withdrawal of the needle. The wire is removed and left in the wound and the needle again carried through the pubic portion of the fascia lata about an inch to the outside of its preceding course and upward through the falciform process of the fascia lata and Poupart's ligament through the integumentary puncture previously made (Fig. 535, A). The other end of the wire is then inserted into the needle and pulled down as before. The lower ends are then twisted together in the incision and the untwisted ends divided five or six inches long and the upper external loop twisted *firmly* down upon the integument (Fig. 536).

*bilical Hernia.*—The instruments required are a stout
, a spoon-shaped concave director, and two pieces of
silvered copper wire, eight or ten inches in length
537). The patient is placed on the back, shoulders
, and thigh flexed on the abdomen, and contents of
reduced. The spoon-shaped
or, with its concave surface
most, is pushed into the open-
the right or left side, carry-
e integument beneath the free
r of its tendinous outline; the
: is then carried along the
ve surface at the upper por-
of the border and thrust
gh the invaginated integu-
fibrous border, and through
perimposed integument. The
: the wire is then introduced
ne needle and drawn through
uncture. The lower portion
e rupture is pierced in the
manner, the skin being drawn
ward to cause the needle to
e at or near the puncture pre-
y made. The second wire is
drawn through in the same
er. The operation is repeated
e opposite side, the end of
edle being introduced first, at
ure first made and carried
beneath the integument situ-
between the fibrous bound-
of the opening. The extrem-
of the wire are then twisted

FIG. 537.

the opening is closed, when they are cut off a suffi-
length to be hooked over a compress of lint and re-
l by adhesive plaster and a bandage.

### STRANGULATED HERNIA.

s is a condition induced in the sac by a constriction
d at the neck or within the sac itself, which obstructs
irculation entirely or in part, thereby exposing the
nts of the constricted portion to the danger of gan-

grene. The operations for its relief are taxis and herniotomy, the latter sometimes being called kelotomy, and in common parlance is "operating upon strangulated hernia."

*Taxis.*—This consists in returning the constricted viscus to the abdominal cavity through the channel of its escape by manipulation aided by force of gravity and the relaxation of the constricting agencies. As a rule it will be found that strangulation occurs to protrusions of long standing, where the patient has become self-educated in the practice of returning it. It therefore follows that when the case is brought to the attention of the surgeon that the patient has made persistent but ineffectual efforts to reduce it; under these circumstances the outlook for his success is not a brilliant one. He should first diagnosticate its variety, that his efforts may be intelligently directed; also its condition, that his efforts may do no further injury to the parts or cause harmful procrastination. If moderate effort be not sufficient to return it, a hypodermic injection of morphia may be given near the seat of the constriction, the patient kept in a warm bath, with the pelvis elevated until the combined influences are felt on the general system. It can thus often be returned without difficulty, either by the patient or surgeon, the former being less liable to employ harmful force because of the pain produced. If these measures fail, and if the strangulation be of recent date and the symptoms not urgent, the patient should be thoroughly dried, surrounded by warm wraps, placed in bed with the foot well elevated and hot applications applied to the parts. These measures are of themselves often sufficient to cause its return. If they fail then *taxis* is repeated, with or without an anæsthetic; if the latter, with the understanding that a failure at reduction will be followed by an immediate operation.

*Taxis is done* by elevating the hips, relaxing the tissues and endeavoring to return the part which last escaped first, in the direction of the channel through which it came. Empty the bowels and bladder, flex the thigh upon the body, adduct and rotate it inward to relax the muscular and fibrous tissues about the groin, grasp the tumor with the right hand, and draw it downward carefully to disengage its neck and at the same time to give to it the proper direction for reduction. Gentle, uniform and continuous pressure is then made upon it by the right hand, while the thumb and fingers of the left steady the upper extremity.

In a few moments the surgeon will be conscious of a slight noise of a gurgling character, followed by a diminution in its size and tension. This is caused by the escape of gas or fecal matter, and will soon be followed by the return of the entire protusion. Properly directed taxis should not be continued longer than fifteen or twenty minutes, when

FIG. 538.

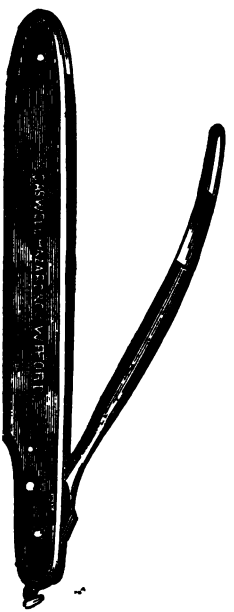


FIG. 539.

FIG. 540.

the herniotomy should be proceeded with. If it be improperly directed the sooner stopped the better.

If taxis be done to a femoral protrusion, it must not be forgotten, if it be a complete one, to *first press downward and then backward and upward.* It not infrequently happens that a large femoral hernia is mistaken for an inguinal one, and efforts are directed to returning it through the inguinal canal.

*Kelotomy.*—The instruments required for this operation are the ordinary scalpel, thumb forceps and artery forceps, scissors, hernial knife (Figs. 538 and 539) and hernia director (Fig. 540), hypodermic syringe, ordinary groove director, needles, and antiseptic materials for dressing. The steps of the operation may be logically divided into six: 1, division of the tissues; 2, recognition of the sac; 3, opening of the sac; 4, examination of the contents; 5, division of the stricture and return of the protrusion; 6, closure of the wound.

*Division of the Tissues.*—After the patient is etherized, parts shaven and cleansed by scrubbing, and suitably placed in a good light, an incision is made through the integument, by transfixion or otherwise, in the long axis of the tumor two or three inches in length. The remaining structures are picked up by the thumb forceps at the lower angle of the wound, nicked, the grooved director pushed beneath and divided with the knife or scissors. The ability to recognize the different layers will depend very largely on the length of time the hernia has existed, as well as the amount of external irritation to which it has been subjected. It is exceptional, however, when many of the layers cannot be easily recognized and separated, especially those of a muscular character and the dense fascia. As the sac is approached, the question which will most annoy the surgeon is, which is the sac? am I without or within it? The sac is recognized 1, by the various layers and their anatomical characteristics; the fascia transversalis which surrounds it being separated from it by the fatty subserous tissue, is quite liable to be mistaken for it. The fascia is dense, opaque, non-translucent and always present. If a like tissue has not been divided before, this, then, cannot be the sac. A minute opening should be made through it at the lower portion of the wound and a grooved director passed beneath, and its division carefully made. The next layer is the subserous fat, which is often quite well marked. If the surgeon has opened the fascia transversalis with the impression it was the sac, he will become somewhat reassured by mistaking the subserous fat for the omentum in the protrusion; this feeling of security will be quickly dispelled, however, when he attempts to find the intestine, or to return the supposititious omentum.

*Recognition of the Sac.*—It is globular in form, of a bluish color, and often transparent. The sense of fluctuation is

often descernible at its lower portion. It can be pinched up between the thumb and finger and its smooth serous surfaces be rubbed together—if they be not adherent to its contents. This is diagnostic. The intestine may be pinched up in the same manner before the sac is opened, when it will quickly and easily escape the grasp on account of the smooth opposed serous surfaces. If a needle be introduced a drop of fluid will escape which is characteristic of a hernial sac. Finally, if the membrane be examined, it will be found to surround and limit the protrusion, being movable only as a whole, denser than the intestine and devoid of its external serous surface. The sac should now be picked up at the fluctuating point, or the point where the drop of fluid escaped, by the thumb forceps and a small

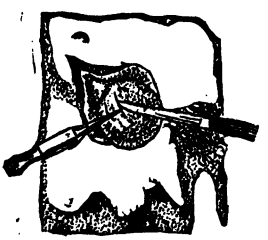


FIG. 541.

FIG. 542.

slit made in it with the knife point at right angles with the forceps (Fig. 541). If fluid be present it will then escape. A grooved director is inserted (Fig. 542) and an opening made of sufficient size to admit the index finger, which is introduced to determine with certainty the tissue just cut as well as the location of the structure (Fig. 543). If the finger be in the sac it will be in contact with smooth surfaces, and can be carried through the neck into the abdomen. If the finger be without the sac it cannot be carried upward without being arrested. The existence of cysts in the line of incision may confuse the surgeon. If, however, the finger be introduced into it, its non-serous lining and limited extent will

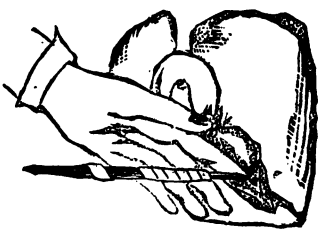


FIG. 543.

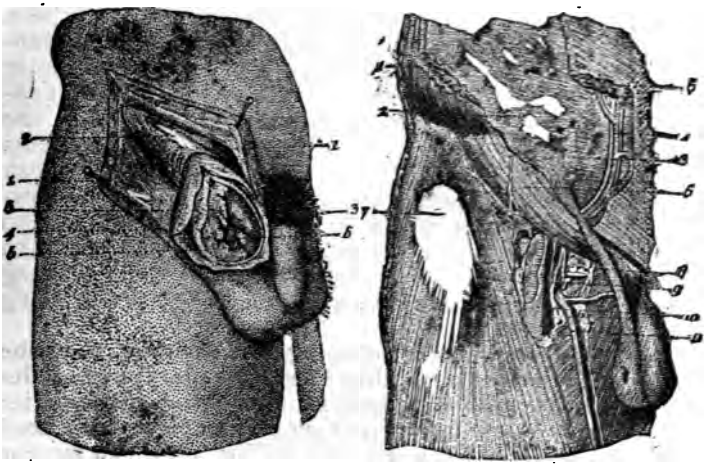
expose the fallacy. The sac should now be opened sufficiently to expose its contents to a careful scrutiny, that the propriety of returning them may be carefully considered.

*Examination of the Contents.*—Under all circumstances there will be more or less injection of the vessels; if the constriction be recent or slight, the changes in the imprisoned tissues will not be great; but when severe or long-continued, the intestine will be of a more or less purple color, or blackish with isolated ecchymoses. All of these appearances may exist and yet the bowel will be of sufficient vitality to recover. The color is not of as much importance in determining a condition of gangrene as the inability to restore the circulation after division of the stricture by the aid of warm fomentations. If the bowel be pricked or slightly scarified and no blood flows; if sensibility be absent and the part becomes cool; if its luster be destroyed and its structure be softed and crackling, it should not be returned; if to all of these be added the odor of gangrene, it should be opened to afford exit to its contents and treated with warm fluid carbolized dressings. It is considered good practice at the present day to excise a circular portion of the intestine corresponding to the gangrenous part and unite the extremities as described under the head of intestinal sutures. If the omentum be gangrenous or very bulky, ligature it near the mouth of the sac and cut it off; if not it can be returned. If the contents be adherent to each other or to the sac, the adhesions can be ruptured if of recent date. It is often necessary, however, to sever them with the knife or scissors; in doing so ligature the vessels with fine catgut as soon as seen. When the adhesions are very firm and limited the corresponding portion of the sac can be dissected off and returned along with the bowel.

*Division of the Stricture.*—The constricting agency may be without or within the sac; the former being the more frequent site. If without it may be divided before or after the sac is opened, the latter being the almost universal custom. If the hernia be a small one, and strangulation has lasted but a few hours without stercoraceous vomiting or other severe symptoms, and be composed of intestine alone, the constriction may be divided external to the sac. This can be readily done by passing beneath the constricted tissues of the neck of the sac, the herniæ director of Levis (Fig. 540), which is cautiously carried upward until the constrict-

ing band falls into the notches at either side of the groove; a probe-pointed bistoury or the ordinary hernia knife is then carried along the groove and the structure divided (Fig. 544); *not freely*, but just sufficiently *nicked* to permit the return of the intestine. When the gravity of the case requires the constriction to be divided within the sac, that its contents can be examined; the finger is carried up to the point of the obstruction, followed quickly by the director, which is employed as in the preceding instance. The edge of the knife should be directed away from important vessels and the extent of the cut be only sufficient to relieve the constriction. If the gut be gangrenous, great caution must be observed in cutting the band, else the adhesions may give way and allow

FIG. 544.



FIGS. 545 and 546.

the bowel to re-enter the abdominal cavity. As soon as the bowel is returned, stop all hemorrhage, unite the wound with catgut carried through the sac, introduce a drainage

tube, apply a compress, dress antiseptically, raise the foot of the bed and quiet the patient with an opiate.

*Strangulated Inguinal Hernia.*—A hernia in this situation may be direct or indirect, either of which can be complete or incomplete. In the indirect or oblique form (Figs. 545 and 546), it enters at the internal abdominal ring, passes downward and forward to, and through the external ring if it be a complete hernia. The constricting agent external to the sac may be located at either the internal or external abdominal rings, and rarely in the canal. The manner of cut-

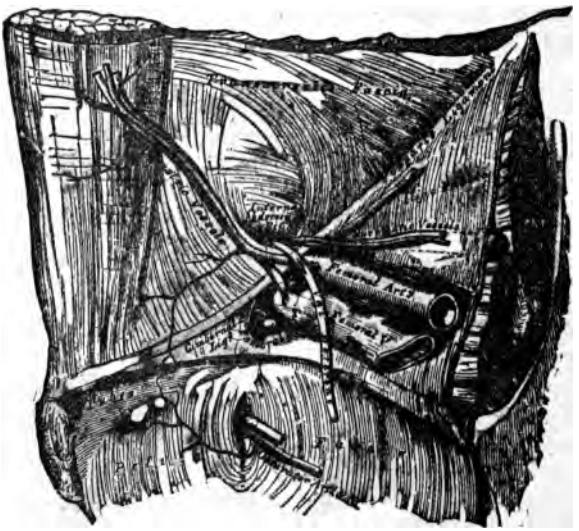


FIG. 547.

ting down upon the sac, detecting and dividing the constriction is described under the general considerations. If the seat of the constriction be at the internal ring, it should be divided upward and outward to avoid the epigastric artery which runs along its inner border (Fig. 547). In fact, in the oblique variety the incision upward and outward is always to be made irrespective of the situation of the constriction. *The only fallacy* that may arise is that of mistaking the direct for the indirect form. In the recent cases this can hardly occur, but in those of long standing, where the traction upon the neck of the sac of the oblique form

has drawn it inward in front of the point of the exit of the direct variety, it is quite difficult and often impossible to distinguish between them. If the neck of the oblique hernia sac be dragged inward it causes the epigastric vessels to be pressed directly against its inner and also to encroach upon its upper and lower borders. Under these conditions, if the stricture be divided agreeably to directions often given—parallel with the course of the epigastric vessels—or even upward and slightly outward, these vessels will be in imminent danger of injury.

If, upon the other hand, the protrusion be of the direct variety, and the incision be made upward and outward,

FIG. 548.

under the impression it be a displaced indirect form, the epigastric vessels will be then exposed to peril (Fig. 548). It, therefore, is readily seen that great caution should be employed in distinguishing between the two, prior to the cutting of the constriction. It is practically impossible to discriminate between them until the coverings of the sac are examined. The oblique variety has for a covering the cremaster muscle, which can readily be distinguished in old hernia. This muscle never forms the covering of a direct hernia except it passes to the outer side of the conjoined tendon, when its coverings are similar to those of the oblique form. It, therefore, follows from the anatomical relations,

that when the cremaster does not form a covering the constriction should be divided upward and inward, that is, away from the epigastric vessels. If it forms one of the coverings, then it must be cut upward and outward, provided there be not evidence that it is a direct one which has escaped to the outer side of the conjoined tendon. This

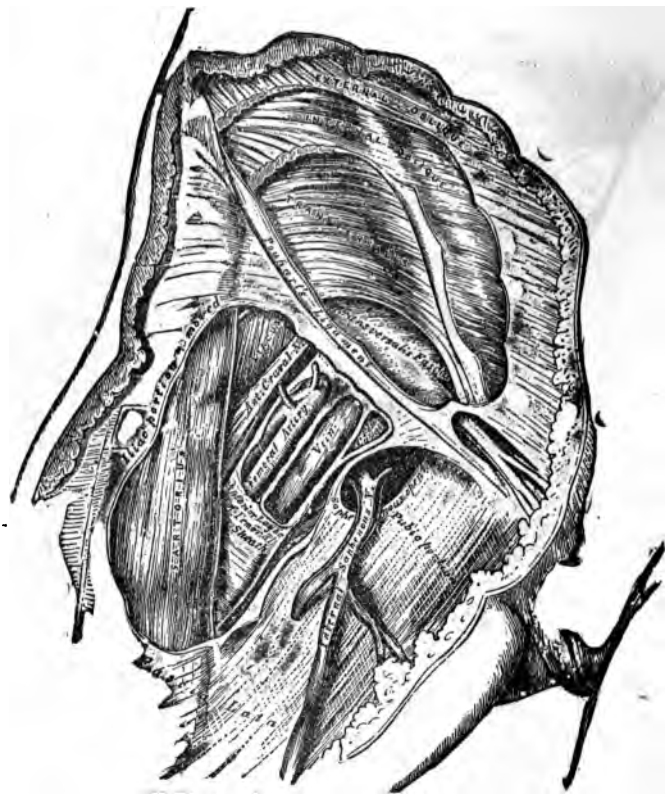


FIG. 549.

latter condition of affairs is fortunately rare, which when taken in connection with the location of the tumor at its incipiency should settle the question between the two. If, however, it be impracticable to settle the doubt, dull the *edge of the* knife by drawing it across a nail or stone, and

then proceed carefully to nick the neck of the constriction in the upward direction. If the constriction be at the external abdominal ring it matters little in which direction the cut be made; however, to simplify matters, upward and outward should still be adhered to. The examination of the contents of the sac and the reduction, together with the subsequent treatment, is sufficiently considered in the pre-

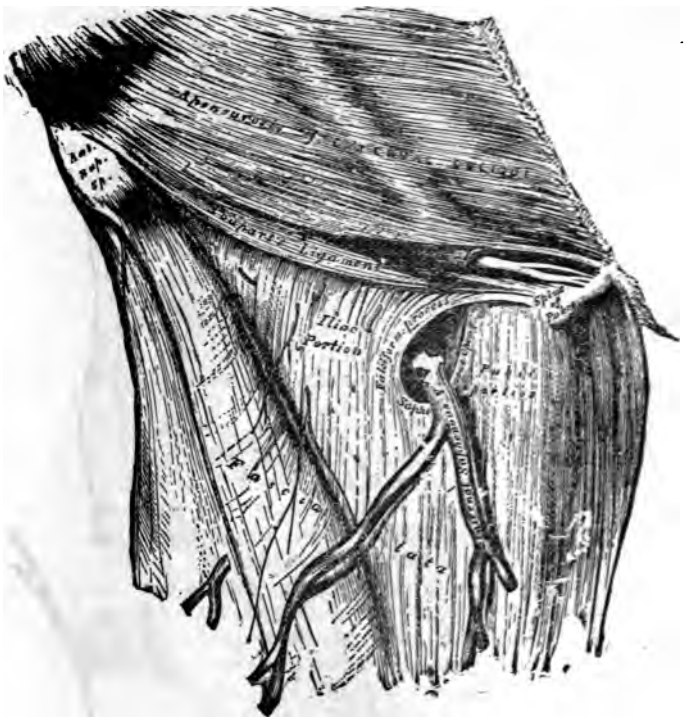



FIG. 550.

ceding pages. If the protrusion be incomplete, the treatment is similar, and the matter simplified by the inability to confound the direct with the indirect varieties.

*Strangulated Femoral Hernia.*—The protrusion in this instance escapes at the femoral or crural ring at the inner side of the femoral vein (Fig. 549), then passes along between the vein and Gimbernat's ligiment, and the inner

boundary of the femoral canals for about a half an inch to the upper portion of the saphenous opening through which it escapes, and in many instances passes upward and rests upon the falciform process of that opening (Fig. 550). The two common points of constriction are: Gimbernat's ligament, and the sharp border of the falciform process of the saphenous opening. The important boundaries of the upper extremity of the crural canal are: within, Gimbernat's ligament; without, the femoral vein, surrounded by its sheath; throughout the course of this canal, the femoral vein lies at the outer side. The distinctive coverings of this protrusion are: the cribriform fascia, crural sheath, and septum crurale, along with the subserous tissues. The important vascular relations are those of the femoral vein and the obturator artery. Taxis should not be employed with this form as long as in the preceding variety, since its constricting influences are the greater, and the neck of the sac much smaller. I must again refer to the fact that a femoral hernia which extends upward towards Poupart's ligament, sometimes extending above it, may be mistaken for one of the inguinal variety, and the efforts at reduction directed to returning it through the external abdominal ring, instead of pushing it downward, backward, and upward, as is necessary to affect a reduction.

The part should be washed, shaved, and disinfected; patient placed on the back, thigh flexed and rotated outward, bladder emptied, patient anæsthetized and an incision made in the long axis of the tumor; the integument and superficial fascia carefully divided, which then exposes the cribriform fascia, which in fleshy subjects is loaded with fat, and this, in conjunction with the glands connected with it, especially if the latter be enlarged, forms a mass often difficult to understand. The glands should be pushed aside, and the remainder of the structure carefully divided. It can hardly be mistaken for anything else than the omentum, or the deeper layer of fatty tissues. The absence of the sac will readily expose the fallacy of the former, after which the latter will be soon diagnosticated.

The femoral or crural sheath is dense, like the fascia transversalis, of which it is a prolongation, and comes next in order. This might be mistaken for the sac did it not present appearances of a different character, which have *already been* described. The septum crurale, if the protrusion be large, will hardly form one of its coverings; it

so, its texture will be much diminished in thickness, and in either instance somewhat blended with the subserous tissue. It sometimes happens that the small lymphatic gland, which normally exists between the subserous tissue and the septum crurale, can be distinguished, which, of course, settles all doubts as to the nature of the tissues under inspection. The careful use of the knife and director soon exposes the sac with its characteristics. It should be opened at the lower extremity with the precautions previously enjoined, and the stricture sought for and divided. If it be, as is usual, at the free border of the falciform process, flex the thigh, rotate it inward, when if no further obstruction exists the protrusion can, if proper, be reduced. If the constriction be at the free border of Gimbernat's ligament, this too must be nicked. It is necessary to remember be-

FIG. 551.

FIG. 552.

fore attempting it, that the obturator artery, once in three and one half cases, arises from the epigastric, and although it usually lies in contact with the vein in its descent (Fig. 552), and is, therefore, out of danger, it not infrequently curves inward along the free margin of Gimbernat's ligament (Fig. 551), thereby nearly encircling the neck of the sac, and is in great danger of being cut. The knife should be made quite dull, and the ligament nicked superficially in several places. The tip of the little finger may then be inserted and the artery felt for; if not discovered, the nicking can be repeated, or firm traction with the finger against the ligament may be made, which will tear or stretch it. This vessel has been severed ten or twelve times during the operation, in each instance the bleeding was controlled without a fatal result. Ligation *and compression* were the principal expedients resorted to.

After the return of the protrusion, the wound is closed and dressed as before.

Femoral herniæ do not always follow the course just described; they do, though rarely, take anomalous courses, sometimes appearing at the outer side, or behind the femoral vessels. They have been known to pass through Gimbernat's ligament. It is important to know that in all the anomalous cases the neck of the sac lies closely associated with the epigastric artery alone, or, together with the obturator, and troublesome and often fatal hemorrhages may be caused unless care be taken.

*Strangulated Umbilical Hernia.*—If the symptoms be not urgent it is recommended that taxis be continued longer than is considered admissible in other forms of hernial strangulation, owing to the greater death rate attending herniotomy in this situation. In the employment of taxis the patient lies upon the back, with the shoulders raised and the thighs flexed. The location and size of the opening can often be defined by the finger before the return of the viscus. The seat of the strangulation is usually at the upper border of the opening. The taxis pressure should be directed upward and backward to correspond to the line of escape. The incision for the operation is made to suit the shape and size of the tumor. All the tissues are divided on a director, and the upper border of the opening sought, since it is at this situation that the constriction is most frequently seated. If it be possible, the stricture should be divided without opening the sac, and the contents returned, if they be not gangrenous. If the stricture be without and the contents in an uncertain condition, a small opening, just large enough to admit of inspection, can be made through the sac. If the stricture be within, the only recourse is to relieve it through as small an opening in the sac as possible.

*Strangulated Obturator Hernia.*—The viscus follows the course of the obturator vessels in escape from the pelvis, and lies beneath the pectineus and obturator muscles. It is usually small and not detected during life.

The incision for its relief is made over the tumor at the inner side of and parallel with the femoral vessels. The constriction has been found in the fibres of the pectineus muscle; it is usually necessary to divide some fibres of the muscle in order to expose the opening through which it has *escaped.* The relation of the obturator vessels to the neck

of the sac vary, being equally frequent at the outer and inner sides. Never in front, and occasionally behind. If the constriction be found at the foramen, it will require much caution to divide it without implicating these vessels.

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## OPERATIONS UPON THE ANUS AND RECTUM.

*Examination of the Anus.*—Place the patient in either one of the four positions: 1, knee and elbow; 2, upon the back; 3, upon the right side, with the knees drawn upon the abdomen; 4, cause the patient to kneel upon a chair and lean over the back.

The one most commonly employed is upon the back in the lithotomy attitude. The position, however, which is most comfortable and at the same time most delicate is upon the side. It is hardly necessary to add that the surgeon should be familiar with the normal characteristics

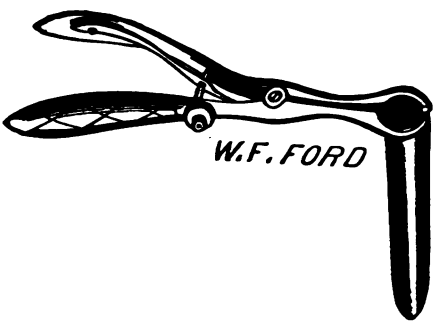



FIG. 553.

of the parts, not only relating to appearances, but to their sensibility and density. On inspection, not only will the presence of the opening be noticed, but the wrinkled appearance of the contiguous integument, the condition of the blood-vessels bordering upon it, and also the white line at the muco-cutaneous junction, which indicate the interval between the internal and external sphincters. The instruments necessary to examine the anus and rectum consist of variously formed specula constructed for that

especial purpose, which may often be wisely supplemented by those intended for vaginal examinations. Sim's speculum, or a simulated pattern of it, made by bending the handle of an ordinary tablespoon at a suitable angle, will be found to be of much use (Figs. 553, 554, and 555). Any

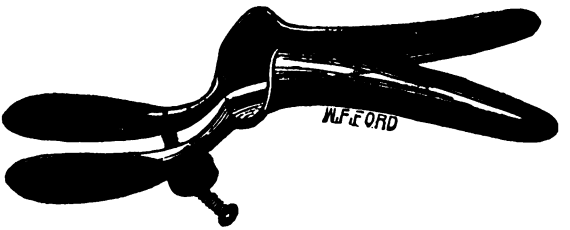



FIG. 554.

form which possesses ample power of adjustment will serve the purpose well.

*Imperforate Anus.*—This depends upon a layer of greater or less thickness which exists between the normal site of the external opening and the bowel above. It may be simply a thin layer of fibro-cellular tissue, which by its pro-

FIG. 555.

jection indicates the nearness of the loaded bowel; not only this, but the emotions of the child may be noted by the movements of the interposed membrane. If it be thin, a longitudinal or conical incision, or even a simple puncture, followed by the careful introduction of a well-oiled finger will be a sufficient operative interference, particularly if the extremity of a suitable sized rectal bougie be occasion-

ally introduced. If the membrane be of sufficient density to interpose an obstacle after the incision, it should be trimmed away, being careful to not include the proper structure of the opening.

*Absence of the Anus* (Fig. 556).—In this all trace of the opening is absent; the median raphé may extend continuously from the scrotum to the tip of the coccyx. The fibro circular interval may be thin or of extreme thickness, as in the preceding instance. If thin, the previously detailed signs may be evident. If they be not present, the occlusion is then of considerable thickness, and may even involve the

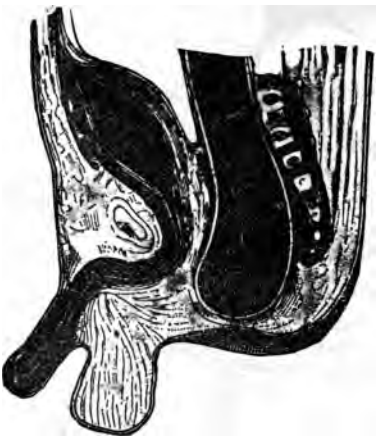


FIG. 556.

length of the rectum itself. The operation for its relief consists in placing the patient, properly anæthetized, in the dorsal position; introduce a sound into the bladder, if the patient be a male, into the vagina if a female; make a vertical incision in the median line from just behind the scrotum or vagina to the tip of the coccyx, continue it carefully upward and backward, shortening each succeeding cut and carefully feeling for the fluctuating extremity of the gut. It is sometimes located posteriorly to the central line and must be sought near the hollow of the scrotum. During the entire progress of the dissection, the situation of the vagina or urethra must be noted by the location of the sound previously introduced. When the dark brown fluctuating extremity of the gut is detected the introduction

of a hypodermic needle will settle all doubt. It should then be seized by a pair of strong toothed forceps (Fig. 557), and draw firmly downward, while its connections with the surrounding tissues are separated by the scissors and fingers. As soon as the cul-de-sac is drawn down to a level with the external opening pass two short ligatures transversely through the sides of the wound, one through its anterior and one through its posterior portion, transfixing the anterior and posterior portions of the bowel in their passage. Protect the raw surfaces with lint saturated with carbolized oil, then open the sac between the ligatures and allow its contents to escape; after having thoroughly

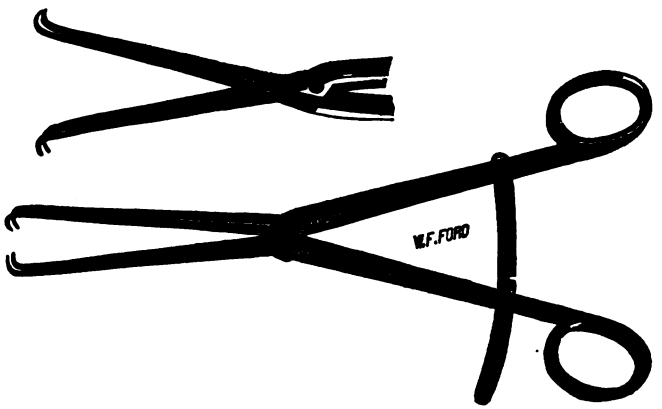



FIG. 557.

cleansed it remove the lint, draw the ligatures through the opening in the bowel by means of a hook, cut and tie them, as in the operation of lumbar colotomy. The mucous membrane should be closely adjusted to the integument, in order to secure perfect union and prevent the contact of the raw surfaces with the discharges. If it be impossible to draw the end of the gut down to the external opening, it can be incised at its lower extremity, and the discharges allowed to escape over the raw surfaces, which are kept opened by the use of bougies; or, the coccyx can be removed, as recommended by Verneuil, and the extremity drawn through the gap and confined as before.

*Fistula in Ano.*—A fistula here, as elsewhere, consists of a sinus, which in this instance leads into the cavity of an ab-

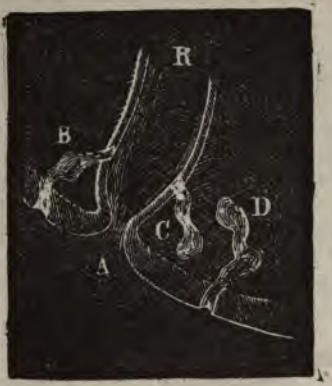



FIG. 558.

R. Anus and rectum. B. Complete fistula. C. Incomplete internal. D. Incomplete external.

FIG. 559.

scess located near to the rectum. It may be either complete or incomplete; if of the latter variety, it may be an incomplete internal or external fistula (Fig. 558). The complete form is the most frequent. In the case of a suspected fistula, before making an examination evacuate the bowel by a cathartic and an enema; place the patient on the back or side, and introduce the well-oiled index finger of the hand corresponding to the side of the patient presenting the external opening. The end of the finger will often detect a nipple-like projection into the bowel, indicating the internal opening. If a flexible probe be then introduced through the external opening, it can with a little care be carried into the lumen of the rectum (Fig. 559). Sometimes, how-

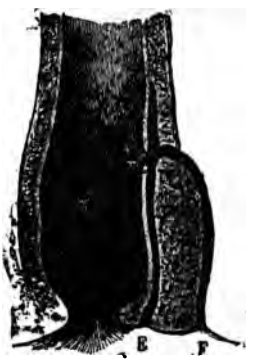



FIG. 560.

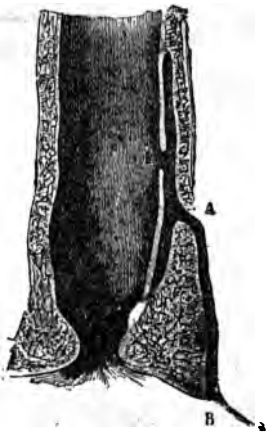



FIG. 561.

ever, the end of the probe will be felt separated from the finger by only the thin mucous lining of the gut; this may be due to the inability to find the internal opening, or to its non-existence. In either instance the thin wall should be perforated, thereby producing a complete fistula. It not infrequently happens that more than one opening communicates with the original abscess (Fig. 560), and also that the mucous membrane is undermined to a considerable extent from a previously existing large abscess (Fig. 561). It is of importance to remember that the introduction of the *finger* and the probe often produces such a degree of con-

traction of the sphincter as to prevent the passage of the probe without great difficulty along the sinus into the gut. The attempt to pass it should not be made until the muscular contraction ceases. It may be advisable to paralyze the sphincter by over distention before dividing the sinus. This causes the parts to remain at rest, adding to the comfort of the patient and hastening recovery. It can be done by inserting the thumbs back to back, flexing the first joints and withdrawing them, or by use of a speculum designed for the additional purpose (Fig. 563).

FIG. 563.

The accepted method of laying open the sinus can be done by direct incision; by the ligature, and by the galvanocautery. The first method is the most commonly employed. The bowel should be thoroughly evacuated by a brisk cathartic on the day preceding the operation, followed by light food. On the day of the operation it should be thoroughly cleansed by one or two copious enemata.

Place the patient on the back, give him an anæsthetic, pass the finger into the bowel as before, introduce a grooved director through the sinus into the bowel; if the end can be turned outward (Fig. 564), then divide the sinus upon it, if not, press it against the finger, and pass a probe-pointed bistoury into the bowel along the groove, after which the director may be withdrawn; the point of the bistoury

pressed against the finger (Fig. 565), and the sinus cut outward with the end thus protected. The finger may be substituted by a wooden director introduced into the bowel, and the division made upon it (Fig. 566). The scissors may be employed instead of the knife, either with or with-

FIG. 564.

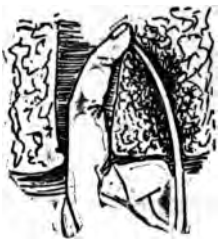


FIG. 565.

FIG. 566.

out its grooved director (Fig. 567). Whenever the depth of the sinus demands the division of the entire thickness of the internal sphincter it should be done at right angles with the course of the fibres (?), never obliquely, to avoid, as far as possible, the danger of incontinence of flatus and feces.

All sinuses should be opened; but, when possible to avoid

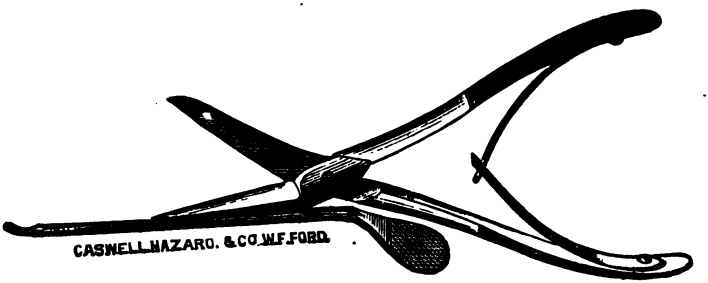



FIG. 567.

it, the sphincter should be divided in but one situation, in order that its integrity be the better restored; also, when practicable, a small portion of the circular fibres should be preserved with the same view. It is not necessary to divide the walls of the abscess above the opening into the gut, since the drainage and loss of power due to the division of the tissues below permits a rapid healing of

these portions. As soon as the sinuses are opened, their pseudo-membranous linings should be scraped or touched with a thermo-cautery, all hemorrhages stopped, the cut packed with oakum or marine lint, a T-bandage applied, patient placed in bed with limbs extended, and morphia or opium freely given to relieve all irritation and to constipate the bowels. The food should be light, and not of a nature likely to leave a residue. In ten days or two weeks make use of a mild cathartic in conjunction with a copious enema.

FIG. 568.

*Treatment by Ligature.*—The elastic ligature is the only one worthy of consideration. This consists of a rubber cord about one tenth of an inch in diameter, which is carried through the sinus into the gut by an appropriate instrument (Fig. 568), the inner extremity drawn out through the anus and tied, after any integument which may be included in its grasp has been divided, to prevent the pain and delay incident to its peculiar structure. A strong silk thread can be substituted for this more elaborate apparatus, which, when passed through the sinus and attached to the rubber cord, can be employed to carry it into position. It is sometimes difficult to tie a knot in the rubber cord securely. This can be accomplished easily by tying the first half of the knot over a silk ligature at right angles with the knot of the elastic one. The silk ligature is then tied firmly around the half knot, thus holding it securely while the tying is completed. The ligature will cut its way through in six or eight days.

This method possesses some advantages over that by incision, among which may be noted, that in simple cases, little or no pain is inflicted, and the patient can walk without danger.

Nervous persons will often submit to it when they will not to the knife. There is no bleeding, which is of ad-

vantage when the larger vessels may be implicated, or a tendency to hemorrhage exists. It is the best method in phthisical patients, for obvious reasons. It can be employed in all cases where but a single sinus exists; if, however, another be present, the result must of necessity be unsatisfactory, as it involves a repetition of the operation or the use of the knife.

The galvano-cautery does not secure better results than incision, and is much more cumbersome in its application; still, it is useful when dangerous hemorrhage is apprehended.

*Examination of the Rectum—Surgical Anatomy.*—Its length is from six to eight inches, the latter being the one of advanced life. It has various curves; the first, an inch and a half in length, extends from the anus to near the prostate, points upward and forward, a fact which should be remembered in the introduction of instruments; the second portion follows the curve of the sacrum and is about three inches in length: the greater portion of this is covered by peritoneum, it being reflected upon it at about two and one-half inches above the anus in front and about five behind, when the bladder and rectum are empty; if filled, the distance is increased about an inch. The anterior surface of the lower part of this portion is intimately associated with the base of the bladder, vesiculæ seminales and prostrate body in the male; in the female the posterior wall of the vagina is in front. The third curve extends from the sacro-iliac-synchondrosis to the middle of third piece of the sacrum. This portion is almost entirely surrounded by serous membrane, and extends from the median line to the left synchondrosis. The vessels having surgical associations with the rectum are the superior, middle and inferior hemorrhoidal; the first is the most important; it runs between the rectum and the sacrum, a little to the left of the median line, to within about four or four and one-half inches of the anus. Its branches run parallel with the long axis of the bowel down to the anus, and can be best avoided by longitudinal incisions.

To accomplish an examination the patient is placed in one of the many positions previously cited. The bowel should be thoroughly emptied and cleansed prior to the attempt. One or two fingers may be introduced, or even the whole hand, or it may be done through the various forms of specula,

If by the index finger, it should be well oiled and inserted with a semi-rotary motion, allowing the remaining fingers to lie in the median line between the buttocks. In this manner, by the use of moderate force, the lower four or five inches may be examined. The introduction of the middle along with the index finger will somewhat increase the range of examination, especially if the patient be requested to bear down. The introduction of the whole hand must be affected with great caution in order not to lacerate the bowel or the peritoneum enveloping it.

The patient should be placed upon the back, anæsthetized, bladder emptied, and the service of a small hand enlisted, which should be well oiled, and a conical form given to the whole by applying the thumb to the palmar surface of the approximated fingers. The tips of the fingers are

FIG. 569.

then inserted by a semi-rotary motion, which is slowly continued until the whole hand enters the bowel. After the entrance of the hand, the fingers should be moved in various directions to ascertain the calibre of the gut and at the same time favor the circulation of the imprisoned hand.

If the hand experience a constriction at a distance of three or four inches above the anus, but little force should be used, as the peritoneum, which is associated with the gut, and is the cause of the narrowing, may be ruptured. If the hand be small, it not unfrequently happens that the sigmoid flexure may be passed, descending colon entered, *and the kidney, uterus*, and great vessels examined. It is, *however, extremely* fatiguing to the hand; but, the discom-

fort experienced should not lead the surgeon to relax in the least the necessary degree of caution essential to the safety of the patient.

*Prolapsus Ani.*—This occurs in two distinct forms: first, a partial or complete prolapse of the mucous membrane alone (Fig. 569); second, a prolapsus implicating the deeper tissues, often attended by invagination (Fig. 570). The operative treatment of the former consists in producing adhesions of the mucous membrane to the tissues beneath it, also to narrow the orifice of the anus by stimulating the

FIG. 570.

function of the sphincter. The adhesions may be established by clamping and destroying isolated portions of the mucous membrane, removing similar portions by ligature or by galvano-cautery. If piles be present, the ligaturing of them will often affect a cure. The application of the Paquelin cautery longitudinally or at isolated points, after the return of the prolapsus, is an excellent method, and when combined with rest in the horizontal position and fluid evacuations, as the other methods should be, will usually effect a speedy and satisfactory cure.

*The patient* must be anæsthetized, placed in the knee-

elbow position, prolapse reduced, and the parts exposed by the Sims' speculum; when four or five longitudinal stripes are made, with the point at a dull red heat, at equal intervals apart, about three inches in length, terminating externally at the border of the true skin. The number, size, and depth of the eschars will depend on the age of the patient and the severity of the case. In the infant, two or three, a line in width may be sufficient. The ability to reanimate the sphincter is somewhat uncertain, yet, the

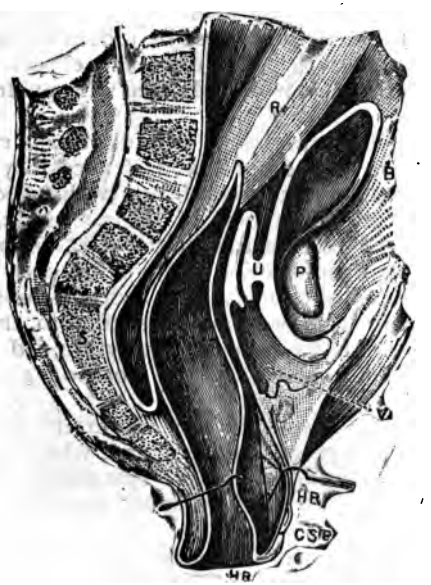



FIG. 571.

medical expedients directed to paralyzed muscles may be employed with some success. The anus may be narrowed by removing elliptical-shaped pieces from the mucous membrane and uniting their raw surfaces.

Expedients of this kind, while they frequently fail, not unusually afford relief to the patient.

*The second or complete* variety of prolapse exists in three forms: 1. In which the external surface is devoid of a sul-

cus; in this the prolapse follows as the result of the continuous traction exerted by long standing prolapse of the mucous membrane. Peritoneum exists in the tumor and sometimes a loop of intestine (Fig. 571). 2. In which a sulcus exists at the base of the tumor, at the bottom of which the lining membrane of the gut can be felt as it is reflected from the invaginated protrusion. 3. In this the finger, when introduced into the anus beside the tumor, fails to detect any evidence of the reflection of the mucous membrane of the rectum upon the tumor. In this the invagination is extensive, involving the colon, caput coli, and sometimes the lining itself.

All three varieties must first be reduced; sometimes this is accomplished with great difficulty, especially when the acuteness of the case is complicated with evidence of strangulation.

The knee-elbow position, careful taxis, returning the part first which last escaped, and if necessary the division of the external sphincter combined with sweet oil and anæsthesia, comprise the best of the successful expedients. To the third variety must be added the copious injection of fluids or gases, introduction of the hand, etc.

The treatment of the last two forms is substantially the same as that for the first variety, except in these it should be more vigorously and persistently applied and the patient confined to the recumbent position and use of the bed-pan.

In the third form of the second variety the question of laparotomy must be considered; and, whether it should be done will depend largely on the symptoms and conditions of the case. Its early performance improves the prognosis for recovery.

*Cancer of the Rectum—Rectotomy.*—Excision of the rectum and colotomy are the only operative measures of practical importance employed in this disease.

*Rectotomy.*—Place the patient in the lithotomy position, empty the bladder, expose the posterior wall of the rectum by a Sims' speculum, and, with the Paquelin cautery, or with a knife make an incision through the mass at the posterior aspect of the gut, about four inches in length, carried downward through the sphincters. The ecraseur may be employed, introducing the chain by means of a trocar passed from the tip of the coccyx upward around the mass into the gut and dividing the included structure

slowly. This possesses only a palliative virtue, enabling the bowel to discharge its contents more readily and with less pain.

*Excision of the Rectum.*—It can be stated as a general guide, that if the upper limit of the growth posteriorly, cannot be readily reached by the finger, that its removal should not be contemplated owing to the contiguity of the peritoneum. The knife, ligature or ecraseur may be employed; the first is the best, and will alone be considered. Evacuate the bowels, place the patient on the back, give an anæsthetic, evacuate the bladder and introduce a sound into it to guide the operator. Make a circular incision around the anus outside the line of the disease, from this carry a straight one back to the coccyx; extend another one in front if it be necessary. If the sphincter be not involved, they should be preserved, or such an amount of either as is possible in order that the contents of the bowel may be controlled. The circular incision should now be carried upward by aid of the knife and finger, and the diseased portion carefully stripped off from the surrounding tissues by the fingers when possible. As soon as the limit of the disease is reached and the hemorrhage stopped the healthy tissues are drawn down, either by aid of its continuity with the diseased, or by silk threads previously or subsequently introduced, and fastened to the cutaneous surface of the external wound and the morbid growth cut away. After this the gut should be carefully united to the cutaneous borders, drainage tubes introduced, and the patient quieted by an anodyne. If the peritoneal cavity be opened, the opening must be carefully closed with catgut after the completion of the excision. It can be temporarily closed by introducing a carbolized sponge. In fact it is always well to push one up the gut before commencing the operation, that the escape of fecal matters may be prevented.

Volkman recommends the entire removal of the sphincter whether it be diseased or not, as he believes the disease is less liable to return, than when it is left.

The prostate and base of the bladder have been removed in conjunction with the diseased rectal tissue.

The rate of mortality following this operation is twenty per cent. The operation is a proper one, and will prolong the life of eighty per cent, and effect a cure in a small proportion of them.

*Stricture of the Rectum.*—This is treated upon substantially the same principles as that of the urethra, the repeated use of rectal bougies passed in the direction of its curvatures; nicking its edges by use of a probe-pointed knife; divulsion, elastic distention and rectotomy; if high up, colotomy.

*Imperforate Rectum* (Fig. 572).—This occlusion varies in thickness and is usually within half an inch or an inch of the anus, which is normal. If it be thin, it will be influenced by the emotions of the child and depressed by the superimposed accumulations. A radiating incision, with its centre corresponding to the centre of the bowel can be

FIG. 572.

made through it, contents of the gut evacuated, flaps trimmed off and the opening maintained by the occasional introduction of a well-oiled bougie. Sometimes the occlusion is so thick as to involve the question of the presence or absence of the gut above. The sigmoid flexure may terminate in a blind point, while the rectum below is marked by an impervious cord (Fig. 573). The attempt should always be made to find the blind extremity, which is done by introducing a sound into the bladder and carefully seeking, by aid of the scissors and finger, for the cul-de-sac above. In doing so, the relation which the rectum bears to the course of the sacrum must be carefully adhered to. If

found, it should be drawn down as far as possible and stitched. If it be not found, colotomy must be performed. Not infrequently the rectum communicates with the bladder, a fact which is determined by the character of the

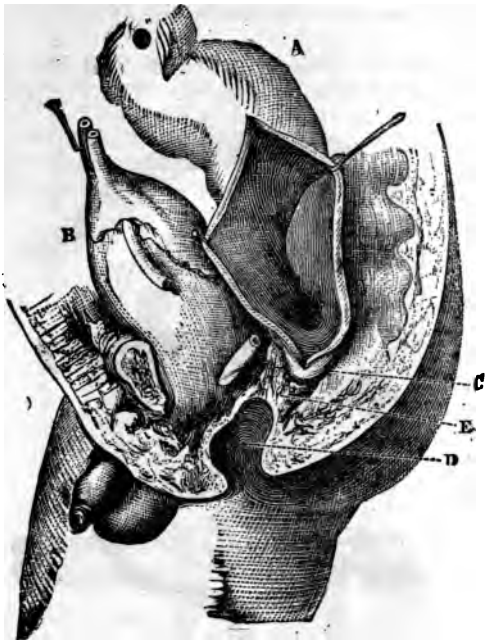



FIG. 573.

urine. In these cases the bowel should be sought for, and when found, drawn down and stitched as before, and the fecal canal kept open by the frequent introduction of the well-greased finger or a suitable bougie. If a urinary fistula occurs, it can be treated in the usual manner.

## OPERATIONS ON THE URINARY BLADDER.

The cavity of the bladder may be explored by catheters and sounds; its outer surface by rectal and abdominal palpation.

Catheters can be practically divided into the soft rubber, gum elastic and metal varieties. The first variety is ex-

FIG. 574.

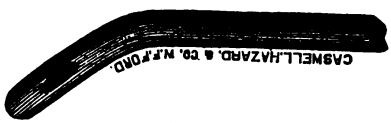



FIG. 575.

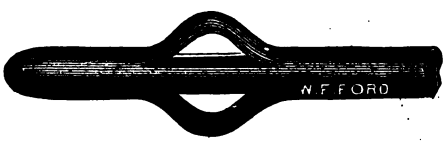



FIG. 576.

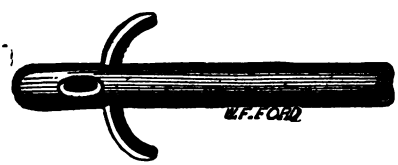



FIG. 577.

tremely flexible, and is a most innocent instrument in the clumsiest hands. It is sometimes necessary that they be provided with a guide in order to properly direct them as well as to overcome any slight impediment in their course. (Figs. 574, 575, 576. 577 and 578.) The gum elastic and

metal instruments are too familiar to all, to require a description except, such as are especially modified for distinct purposes (Figs. 579, 580, and 581).

*Introduction of a Catheter or Sound to the Bladder.*—Select an instrument of a suitable curve and size; place the patient on the back, with the shoulders somewhat raised, and the thighs slightly flexed on the abdomen, and rotated outward to relax the abdominal muscles; warm and smear the instrument with oil or vaseline; stand on the left side of the patient; grasp the penis with the middle and ring fingers of the left hand and raise it vertically. The catheter or sound is then taken lightly between the thumb, index and middle fingers of the right hand and introduced into the meatus, held open by the left index finger and thumb. The instrument and penis should now lie close to the body in the line of the groin. The penis is then gently drawn over the instrument, which at the same time is carefully pushed, or allowed to enter by its own weight into the canal. After about five inches of the instrument has disappeared the outer extremity should be carried toward the median line of the

FIG. 578. FIG. 579. FIG. 580.

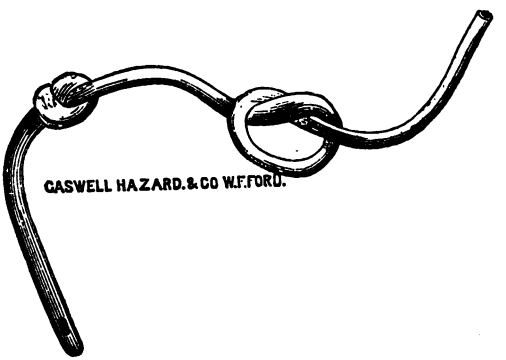



FIG. 581.

body of the patient and elevated slowly to a vertical position, when the weight of the instrument will usually cause

the advancing end to pass beneath the pubes, after which the upper extremity is depressed between the thighs, causing the point to enter the bladder. Not infrequently the end will hitch upon the triangular ligament as it passes beneath the arch of the pubes. This can be obviated by raising the point of the instrument at this situation by the finger pressed firmly against the median line of the perineum, accompanied by upward traction as the point is being advanced. In a word, causing the instrument to hug the roof instead of the floor of the canal. The beginner is apt to carry the handle of the instrument between the thighs too soon, causing the beak to be reversed in front of the pubes. Under no consideration must violence be employed in introducing a catheter, *ars non vis* being an almost traditional axiom in this connection. The surgeon should always follow the advancing end of the instrument with the mind's eye, aiming to keep it in the axis of the urethral curve. The first approach of the instrument to the perineal portion of the urethra not infrequently causes a constriction of the muscles of this region, which interpose an effectual obstacle to its advancement. If, however, the patient's attention be engaged in conversation and so diverted from the procedure, while at the same time the end is pressed continuously and carefully against the obstacle, it will soon give way and it will enter the bladder without further trouble. If it be a catheter, the flow of urine usually announces its entrance to the bladder. However, if the catheter be obstructed, or a sound be introduced, its proper situation may be determined by rotating it on its long axis; if the beak be in the viscus, its extremity will describe the arc of a circle around its shaft as a centre. If not, then the shaft will describe a circle around its beak. If the bladder be empty or contracted the impinging of the beak upon its walls may deceive the beginner and also cause the patient much pain. The introduction of the finger into the rectum will aid in guiding the instrument into the bladder, and determine the fact of its entrance as well. Hot application to the abdomen, together with an anodyne and a ten-grain dose of quinine, should be employed if an urethral chill be feared.

*Retention of Urine.*—Depends upon some obstruction to its egress, located at the neck of the bladder, or in the course of the urethra. Also upon paralysis of its muscular coats, or both combined.

The indications are met by overcoming the obstruction and restoring tone to the bladder. If the obstruction be due to stricture, and it be permeable, catheterization will effect ready relief. It is important to know, however, that the bladder should not be entirely emptied of its contents, but that a sufficient amount should be drawn to afford complete relief from all pain and tension. If it be completely emptied, its walls collapse from want of support, its lining often becomes congested, and in all probability the catheter will be required at the next attempt at urination. If but a third or a half be withdrawn the bladder will probaby expel the remainder at the next desire to micturate. If it be impossible to introduce the ordinary catheter, even of a small size, recourse must then be had to the filiform bougies (Fig. 582), and whale-bone guides (Fig. 583). The latter are the most commonly employed. The patient is placed in the dorsal position, an anæsthetic given, unless the bladder be much distended—as then there is danger of its rupturing during the struggles of the patient. If anæsthesia be necessary under such circumstances, it is advisable to relieve the bladder of some portion of the fluid by supra-pubic aspiration. If one be not entirely familiar with the use of the guides and the retention catheter, anæsthesia is not advisable, as then, the patient's sensations cannot be consulted, and great harm might arise from their use. The urethra should be forcibly filled with sweet oil by means of a syringe, and

FIG. 582.

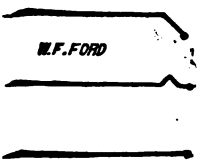



FIG. 583.

the end of the penis grasped to retain it as long as possible, leaving sufficient room for the introduction of the whale-bone guide. A guide is carefully introduced, and if its point becomes engaged in a lacuna, it is withdrawn a *little and again* carried onward with a rotary motion. If it

enters a false passage it is retained there by the left hand, while another is passed by its side. If a second enters the false passage it is treated in a similar manner, and so on until four or six, or even more are contained in the canal, some of which have the spiral and others the straight end foremost. They are each taken separately and pressed onward with or without the spiral twist, always remembering to use no force, else the small points may pierce the mucous membrane of the urethra, or enter and perforate Cowper's ducts. As soon as all the side openings are closed by their points, one will be found to have entered the stricture,

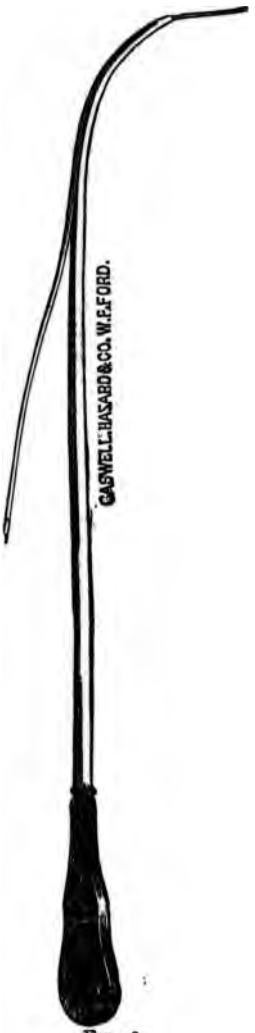



FIG. 584.

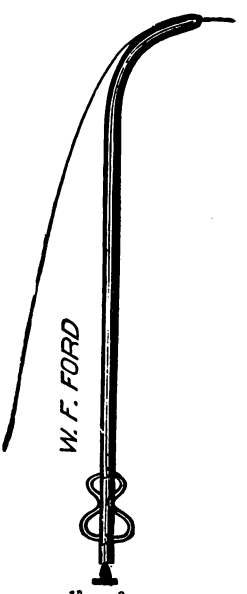



FIG. 585.

and with a little coaxing will pass into the bladder, which *is known by the* painless ease with which it can be moved

in and out. The others are then withdrawn and the end of the one remaining is passed through the eye of a tunneled sound (Fig. 584), or what is better the tunneled catheter (Fig. 585). This one serves as a guide to the passage of the instrument into the bladder, which should be done with caution, as the guide may be cut by the eye of the instrument, causing the guide to double and lead the end of the catheter astray. After the requisite amount of urine is withdrawn, a tunneled sound of larger size may be passed in a similar manner as the catheter, after which the guide can be taken out and an ordinary steel sound of small size carefully introduced to insure a channel of sufficient capacity to admit the ready entrance of an instrument thereafter.

*By Aspiration.*—The contents of the bladder can be removed by aspiration. This, however, is a temporary affair. The same can be said of tapping per rectum. There are important expedients to enable the surgeon to gain time for the performance of external perineal urethrotomy.

*Rupture of the Bladder.*—This occurs most frequently on the posterior surface involving the peritoneum and allowing the urine to escape into the abdominal cavity. When the rupture occurs anteriorly, the extravasated urine infiltrates the perineum and the anterior walls of the abdomen.

Free incisions to relieve the extravasation and the performance of cystotomy, together with the opening of the abdomen in the median line to remove the urine contained in it, are the practical operative procedures.

*Cystotomy.*—This consists in opening into the bladder through the median line of the perineum, as in the median operation for stone. Place the patient on the back, evacuate the rectum, introduce a staff into the bladder, and with a sharp knife make an incision in the median line about two inches in length, terminating about half an inch in front of the anus; by repeated applications of the knife the grooved staff is reached and the membranous urethra opened from the apex of the prostate backward. Introduce a small probe into the bladder by way of the groove, withdraw the staff and introduce the index finger into the bladder on the probe as a guide, and distend the neck sufficiently to cause the urine to escape as fast as it flows into the bladder. The prostate may be incised on either one or both sides, as in lateral and bilateral lithotomy. The prostatic structure must be well dilated, else it will soon return to its normal situation and require a repetition of the operation. This opera-

tion is now quite frequently performed as an ultimate expedient in obstinate cystitis of both sexes.

In the female, the incision is made into the bladder through the vagina.

*Extroversion of the Bladder.*—In this the anterior wall of the bladder and abdominal parietes are absent, while the posterior and inferior portion of the bladder protrudes through the opening on account of the pressure of the viscera from behind. Mr. Simon made an attempt to connect the ureters with the rectum, but with indifferent success. Floyd and Johnson attempted to establish a fistulous communication between the bladder and rectum by means of setons. The patient died shortly with peritonitis. Various other measures have been attempted to establish a more feasible channel for the escape of urine, none of which, however, have afforded any practical relief. The methods by autoplasty are the most rational and have in many instances afforded relief.

*Dr. F. F. Maury's Operation.*—Make a curvilinear incision, with the convexity upward, on each side, extending from the outer third of Poupart's ligament downward and inward below the scrotum to the middle of the perineum, at which point they become joined (Fig. 586). This flap, 2, is dissected upward to the root of the penis, which is slipped through a valve-like incision made at the base, which permits the urine to escape without coming in contact with the raw surfaces. A second or abdominal flap, 1, is now made transversely across the abdomen below the umbilicus, being dissected up from below. The lower flap is then turned upward to bring its cutaneous surface in contact with the mucous surface of the bladder. The edges of the lower flap are then beveled and carried under the upper flap by means of the tongued and grooved sutures (Fig. 587). This method offers the best results in operations upon males. Bigelow dissected off the mucous membrane of the exposed bladder, constructed lateral flaps from each inguinal region, united them in the median line and above (Fig. 588), thereby securing a perfect result (Fig. 589).

FIG. 586.

*Wood's Method.*—(Fig. 590). This is best adapted to female subjects and consists in making a central or umbilical flap, *a*, and turning it downward over the bladder, after which a flap is made from each groin, B C, and carried in-

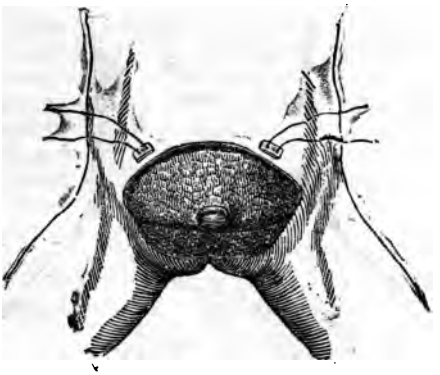


FIG. 587.

ward over the everted central one and united in the median line to the other (Fig. 591). This arrangement brings the integumentary surface of the central flap in contact with the mucous surface of the bladder and the raw surfaces of

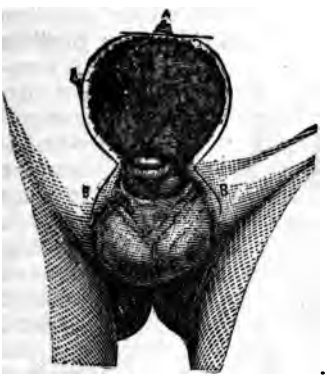


FIG. 588.

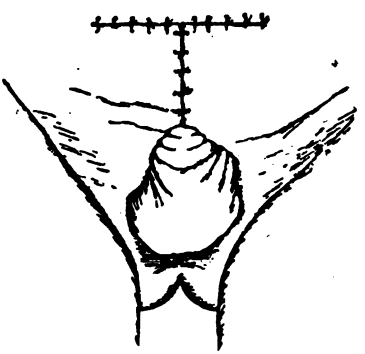


FIG. 589.

the central and lateral flaps are apposed; the uncovered raw surface above being allowed to heal by granulation.

Some fifty-five cases have been operated upon by one

method or another with the satisfactory results of forty-three successful cases. Four were failures and eight fatal.

*Puncturing the Bladder.*—This is done to relieve the organ from over distention. It can be done above or below the pubes and through the rectum.

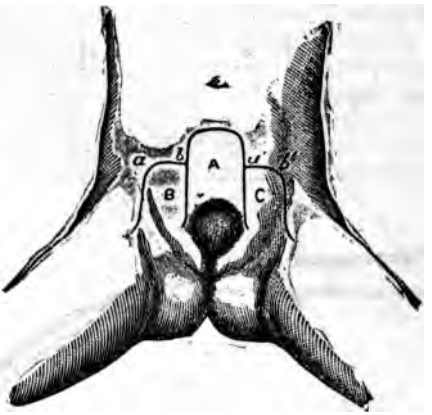



FIG. 590.

It may be accomplished by the ordinary curved trocar (Fig. 592), or by the aspirator, the latter being the safer and more satisfactory.

*Above the Pubes.*—Place the patient on the back; outline

FIG. 591.

the distended bladder by percussion; explore it with a hypodermic needle if a doubt exists as to its nature. Select a small, straight or curved trocar, the latter being the better. Make the skin tense about an inch above the pubis,

and push it through the median line with the convexity upward. An initiatory incision through the skin is often made with a sharp knife which permits the easier entrance of the trocar.

*Under the Pubes.*—If the bladder be small and shrunken behind the pubes, and the prostate be too large to admit of the rectal puncture, the penis can be pulled downward and a small curved trocar with the concavity upward passed just beneath the arch of the pubis into the viscus.

*Through the Rectum.*—Place the patient in the lithotomy position; introduce the left index finger into the rectum; locate the vesiculæ seminales and base of the prostate;

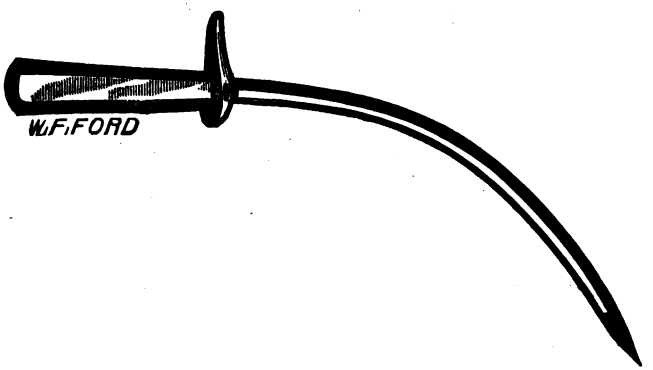



FIG. 592.

place the end of the finger between the former, allowing it to rest upon the base of the latter, and along the palmar surface, a curved trocar (Fig. 593) is carried just above the base of the prostate and pushed into the bladder; the canula may be tied in position, or a soft catheter substituted therefor, by passing it through the canula.

The almost universal practice of using some form of aspirator and the superiority of this instrument over the trocar is fast consigning the latter to an honorable remembrance only.

## STONE IN THE BLADDER.

This morbid condition is quite common and usually accompanied by well marked and characteristic symptoms. Sometimes, however, calculi of inordinate size and with

FIG. 593.

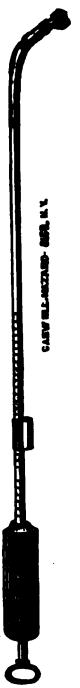


FIG. 594.

FIG. 595.

FIG. 596.

unusual asperities are attended by trifling manifestations. When it is suspected that a stone may be in the bladder, proof of its presence is sought by aid of the searcher. Of these instruments there are various patterns (Figs. 594, 595,

and 596). The one devised by Thompson is most commonly employed. The former can be used for the double purpose of varying the amount of water in the bladder by injecting or allowing it to escape, thereby better accommodating the walls to the remaining function of this instrument—sounding for the stone.

*Sounding*.—Care should always be taken, and the time selected when the patient is suffering the least from the bladder difficulty. If the patient be a child, an anæsthetic should be given; if an adult, only occasionally, when he is extremely restless from the pain.

Place the patient on the back with the hips raised, the operator standing upon the right side. Introduce a searcher in substantially the same manner as that employed in introducing the lithotrite; then push it carefully to the posterior wall of the bladder, with the end upward; withdraw it slightly to give easy play to the end, and carefully turn the beak from side to side, until the lateral wall of the bladder is touched. This is done by rotating the instrument on its long axis between the thumb and finger. In this manner the whole inner surface of the bladder is examined, the instrument being withdrawn each time a sufficient distance to accomplish this object thoroughly. As soon as the beak comes in contact with the neck of the bladder it can be withdrawn. If the prostate be enlarged, the handle should be depressed and the beak turned toward the floor of the bladder and rotated from side to side while it is being gradually withdrawn. This manœuvre will be quite sure to detect the stone if it be wedged behind that body.

If no stone be detected, it is better to make a second, and even a third examination before positively asserting that none is present. The urine of one or two hours' secretion should be allowed to collect in the bladder or its equivalent, four or five ounces of warm water may be injected before attempting the sounding. Five or ten minutes is quite sufficient time to employ at one sitting. If presence of stone be detected, their number, size, and probable consistency should be determined. After the searching is completed apply warmth to the hypogastrium, give an anodyne along with ten grains of quinine, and keep the patient quiet.

Lithotrity, litholopaxy, and lithotomy are the only practical methods of relief in the male.

*Lithotrity* is the reducing of stone to fragments so minute as to allow of their easy escape with the urine.

FIG. 597.

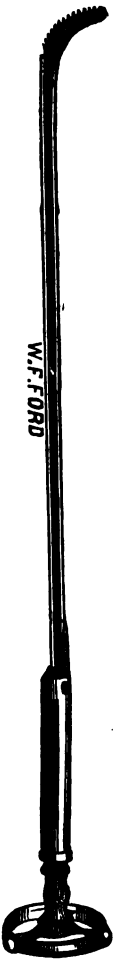



FIG. 598.

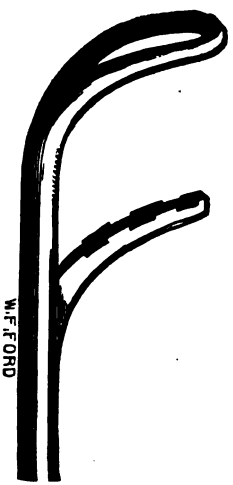



FIG. 599.

The instruments used to effect this reduction are called lithotrites, of which there are several varieties (Figs. 597, 598, 599, 600, and 601). The ones bearing the ingenuity of

Thompson and Bigelow are most frequently used. The patient should be in good condition and the urethra of suitable size to admit the lithotrites; he is then required to hold the urine for an hour or two, is then placed upon the back with the pelvis elevated; the older the patient the greater the elevation should be. An anæsthetic may be given, and should be, if it is the intention to triturate the entire mass at one sitting; or, if the patient be irritable or the bladder over-sensitive.

*Introduction of the Lithotrite.*—The operator having chosen and well oiled a suitable instrument, stands upon the right side of the patient, taking the penis in the left hand, inserts the beak and draws the member upward upon the instrument, which is tightly grasped by the right. The handle is slowly raised until the shaft becomes vertical, when it is transferred to the left hand and the fingers of the right are placed on the perineum to follow the angle of the beak as

FIG. 600.

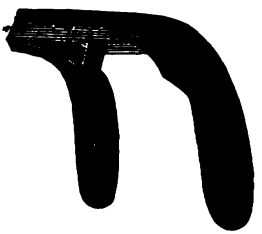


FIG. 601.

it advances. The weight of the instrument will cause it to sink low enough to permit the beak to engage the opening of the triangular ligament through which the urethra passes. A little careful manipulation aided by the right hand in the perineum will cause it to enter this portion of the canal, when the handle of the instrument should be taken by the right hand and slowly allowed to fall of its own weight between the thighs. If the instrument be now slightly pressed upward its upper extremity will be found to be disengaged, and can be easily rotated upon its long axis. If the prostate be enlarged it increases the length of the deepest portion of the urethra and interposes an obstacle to its progress. The handle should not, therefore, be depressed so rapidly during the latter stage, and must be carried further upward. Under no consideration should any undue force be used. The weight of the handle is of

itself sufficient, unless under proper control, to lacerate the soft urethral tissues.

The instrument is pressed upward in the line of its entrance until it reaches the posterior wall of the bladder, unless it be sooner interrupted by the stone, when the beak is turned from it and the male blade withdrawn, after which the separated blades are turned towards it, the stone seized and fixed. The beak is then turned upward, being careful to observe that the mucous lining of the bladder is not caught, and the fragment crushed. The blades are again separated and turned sidewise to catch the resulting fragments, which manœuvre is continued until the sitting is completed.

During the crushing, the female blade must be held firmly and caused to act in an entirely passive manner. The blades should only be separated sufficiently to admit the stone between them, which is grasped, and they should not be separated until the beak assumes a perpendicular position. If the beak be not turned away from the stone before it is opened it may be displaced by the separation of the blades. While it is true that in a large majority of these cases the plan of action just described will suffice, yet in those where the prostate is enlarged, or an excavation exists at the base of the bladder from another cause, it becomes necessary to reverse the beak of the instrument, causing it to look towards the rectum To do this properly the handle of the instrument is depressed until the beak is elevated sufficiently to allow of the revolution without impinging upon the walls of the bladder. If the simple reversing of the instrument does not bring it in contact with the stone, the beak should then be turned in various directions with care. Another manœuvre, which in the case of small stones located behind the prostate will often prove successful, consists in drawing the reversed beak outward until it nearly touches the prostate, and then separating the blades by pressing the female blade backward until it strikes against the wall of the bladder, the male blade being held firmly in position; raise the handle until the female blade rests lightly upon the floor of the bladder, then draw it forward to join the male, lightly touching the floor in its course. If a stone lies in the line it will be touched, and, moreover, the mucous membrane will not be pinched. It is better that the blades be smooth in these reversed movements.

When the sitting is completed the blades must be screwed firmly together that the instrument may be withdrawn without injury to the urethra. During the antero-posterior manipulation the neck of the bladder should be carefully preserved from any unnecessary contact with the instrument. Each sitting, if without anæsthesia, should not exceed five or ten minutes; with it, a sitting can be prolonged until an ordinary calculus be reduced to fragments. The intervals of the crushing will depend upon the size of the stone, its hardness, and more frequently the effect upon the patient. Inasmuch as the conditions differ greatly, it is impossible to lay down any stereotyped rules. The surgeon should not repeat the operation until the subsidence of the irritation produced by the previous attempts. Villous growths of the bladder, and deformities which interpose a mechanical obstruction are the principal contraindications to lithotrity. After the completion of the sitting the patient is given an anodyne, and hot fomentations are applied to the abdomen. He should remain in the recumbent position for twenty-four hours subsequent to the attempt.

FIG. 602.

The rate of mortality is about 11 per cent.

*Rapid Lithotrity, or Litholopaxy.*—The crushing and washing out of a stone at a single sitting has supplanted the ordinary lithotrity.

The instruments usually employed in this procedure are the lithrotites of Thompson or Bigelow, as shown in Figs. 597 and 599, the latter being the one in common use. The blades of lithrotites differ in their grinding surfaces, from a simple roughening to a well-marked denticulation. The blades of the Bigelow instruments present appearances peculiar to themselves (Figs. 602, 603, and 604). The instrument used by Dr. Keyes is of a stronger pattern than is usually employed, and is provided with a

large wheel at the end, that a greater force may be quickly applied. The blades are fenestrated (Fig. 605) and cannot clog. The operator should possess lithotrites of two or

FIG. 603.

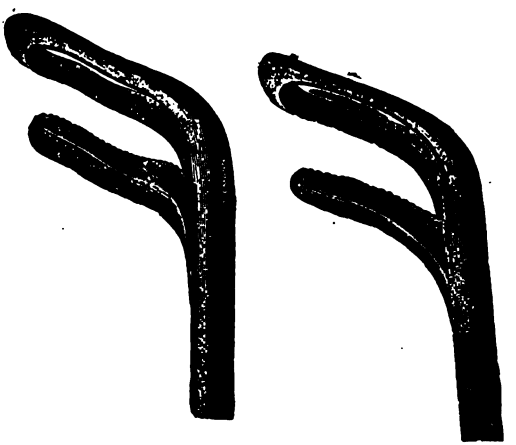


FIG. 604.

three sizes to enable him to comply with the demands of individual cases, as modified by the hardness and size of *the stone,* size of the urethra, etc. For crushing large and

hard stones a fenestrated blade should be employed. If the stone be small and friable, the blades may be roughened only, with the male blade the smaller. Blades of equal

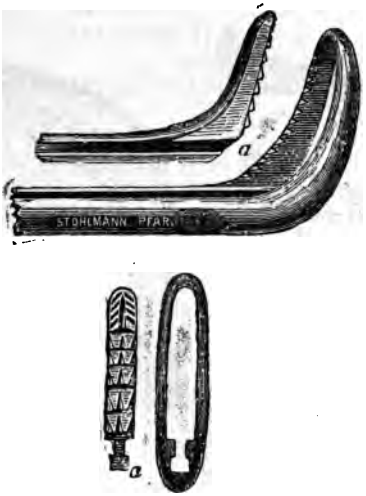



FIG. 605.

size can be used to pulverize the smaller fragments. The larger and harder the concretion the stronger should be the instrument employed. In addition to instruments for

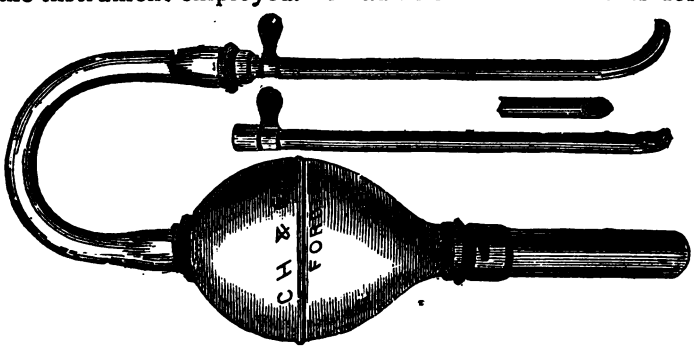



FIG. 606.

crushing, the operator must be provided with an evacuator (Figs. 606 and 607), to which may be at

stand. The Thompson washer is simpler but more liable to admit air into the bladder. The latest pattern of Bigelow avoids its entrance. The evacuating catheters (Fig 608) of Bigelow, or their modifications, complete the outfit. The spiral tip of Warren (Fig. 609) is thought by him to more easily admit the detritus.

The contraindications of the operation are of a limited number.

It is not admissible, if the bladder be sacculated and accompanied by cystitis, or if it be ulcerated, or intolerant of the pressure of instruments, or contains morbid growths, and the patient be feeble; especially, if the stone be large and hard.

The preparatory treatment consists of alleviating all

FIG. 607.

symptoms depending upon the existence of the stone and preparing the urethra for receiving the instruments, by increasing its size if necessary, and subduing any undue sensibility.

*Operation.*—One assistant beside the one to administer the ether should be present to empty the washer and adjust it. The bladder should contain four or five ounces of fluid, which is best accomplished by causing the patient to retain his urine for two or three hours prior to the operation; or, if it be empty, a similar amount of tepid water must be injected. If the contents of the bladder be offensive, evacu-

ate it and wash it out with a tepid solution of borax a drachm to the pint, before beginning the operation.

The patient is placed on the back, pelvis elevated, thighs

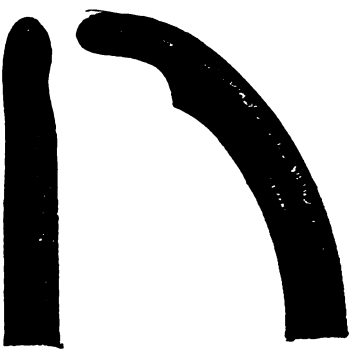


FIG. 608.

FIG. 609.

slightly flexed and rotated outward, and an anæsthetic administered.

The introduction of the lithotrite, catching and crushing of the stone, are similar in this operation to the ordinary method, except that the crushing process is interrupted by

the introduction of the evacuating catheter as soon as the stone is well broken—which may be within five or ten minutes of the introduction of the lithotrite, depending, of course, upon the success attending the efforts of the operator. A well-oiled evacuating catheter is then passed down to the prostatic urethra and the washer is attached—being careful to exclude the air—while it is in this situation to avoid the entrance of air into the bladder. The air in the

FIG. 610.

catheter while thus located will pass upward through the water in the washer and remain in the air-trap above. If, now, the elastic bulb of the bottle be alternately compressed and expanded, the changing current thus produced will wash the fragments from the bladder, and their weight will precipitate them into the glass receiver. If all the fragments be not removed, which can be ascertained by the introduc-

tion of a searcher, crushing is again done and the resulting comminutions treated as before until all the stone is removed. The last fragment not infrequently eludes the grasp of the instrument, and were it not that it can be heard to strike the catheter when the water is drawn, its existence would not be suspected. It is better sometimes to allow it to remain until the patient has recovered from

FIG. 611.

the operation and then attack it again, than to continue indefinitely the attempt to secure it at the first sitting.

The period that the first operation may be prolonged is not an arbitrary one: an hour or two is not unusual, and even longer. However, an hour is a safe rule to adopt.

After the operation the patient is kept quiet and in bed, well wrapped; and retention, if it occurs, relieved by a catheter.

The operation has various sequels. Rigors, retention of urine, cystitis, impaction of stone in the urethra, pyæmia, atony of the bladder, suppression of urine, etc., all of which should be treated on general principles. Under ordinary circumstances the patient should be up and around at the end of a week or ten days. The rate of mortality is about three and one-half per cent.

*Perineal Lithotrity.*—A stone may be crushed by gradual or rapid lithotrity through an opening in the perineum. This plan has as yet been rarely adopted as the primary method, but rather as an expedient to facilitate the removal of stones too large to be removed through the incision made for the

FIG. 612.

purpose of simple lithotomy. It has been broached as a substitute for lithotomy, since the crushing, and the use of the washing apparatus can be substituted for the incision through the deeper parts. Still the withdrawal of an ordinary sized stone can hardly compare in point of danger to the repeated introduction of instruments and the necessary prolongation of the operation of crushing. It is without doubt an expedient which should be more frequently adopted, especially for the removal of stones through an opening too small to admit of their safe passage.

Prof. Dolbeau systematized this method. The incision can be made through the perineum, as in median lithotomy,

after which the dilatation is divided into three steps, the dilator of Mr. Dolbeau being employed. The first step con-

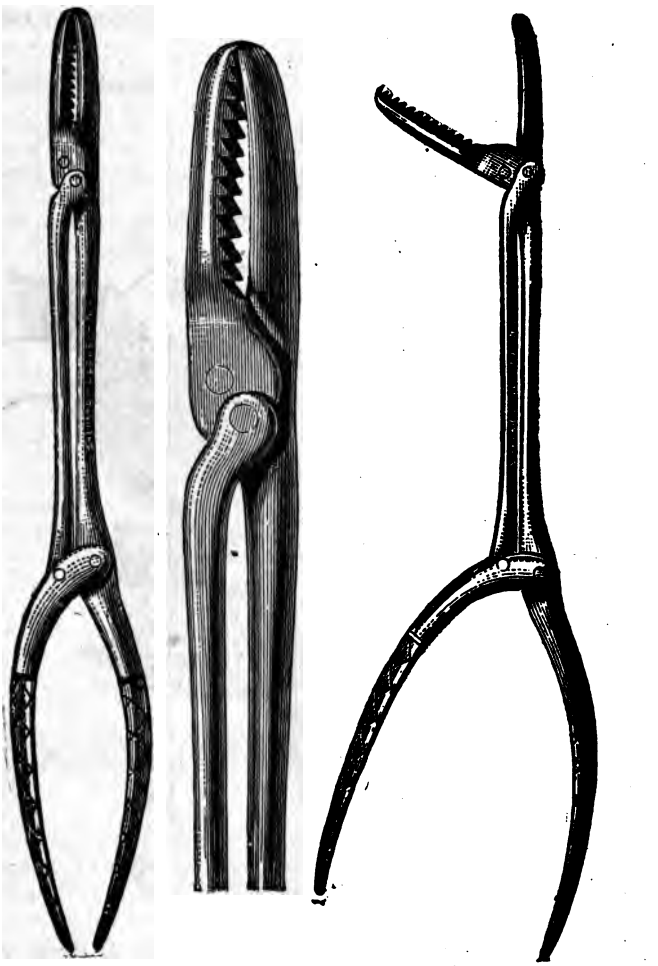


FIG. 613.

sists in the dilatation of the tissues down to the groove in the staff (Fig. 610). The second, nearly through the neck

of the bladder (Fig. 611). Third, withdrawing the staff and carrying the dilator in sufficiently to thoroughly dilate the neck of the bladder (Fig. 612).

The dilatation in all the steps must be done carefully,

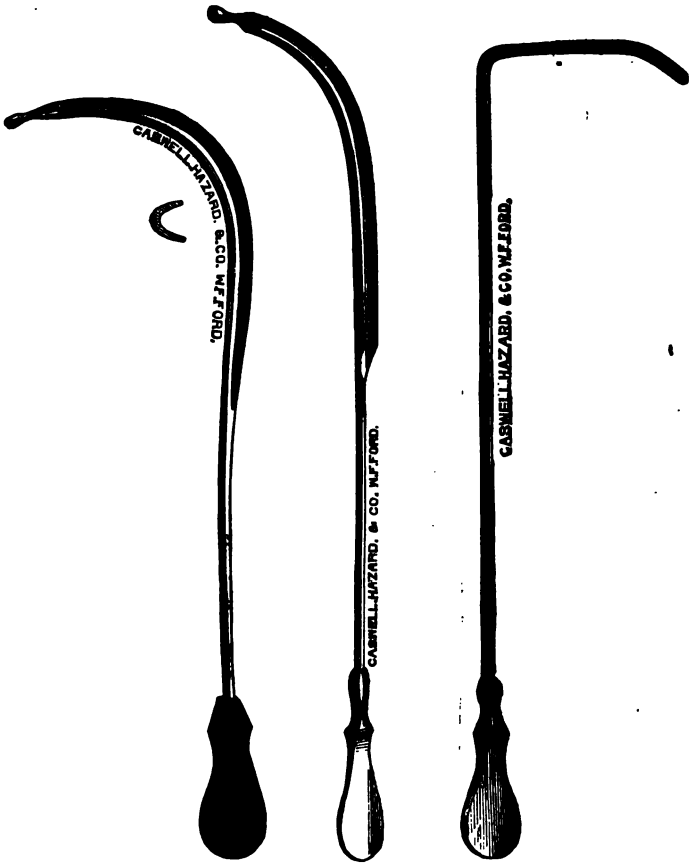



FIG. 614. FIG. 615. FIG. 616.

and in accordance with the resistance encountered. After it is completed, a lithoclast (Fig. 613) of suitable size is introduced, and the stone fragmented: after which it is removed in a similar manner to the fragments in lithotrity. The results are very satisfactory.

*Lithotrity in the Female.*—The absence of the prostate, the shorter and larger urethra, all of which combine to the more complete emptying of the bladder, for the same reason lessen the liability in the female to the formation of vesical calculi. A stone in the female bladder is not grasped with the same facility as in the male, owing to the difference in the normal shape and surroundings, also to the pathological modifications of its cavity, to which it is subject, due to its connections with the uterus and vagina, and their physiological and pathological variations caused

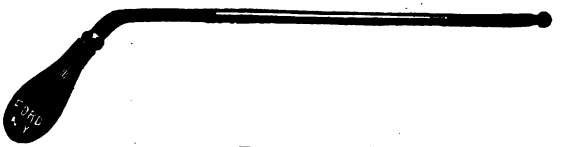


FIG. 617.

by child-bearing and its sequels. The greater liability to a saculated base, requires that the instrument be reversed more frequently than in the sterner sex. The operation can, however, be performed, and aside from variations of manœuvres to catch the stone, differs but little from that in the male.

*Lithotomy* is the operation for the removal of stone from the bladder by cutting. The varieties of removal in common use are those classed as the median, lateral, and bilateral, together with the occasional employment of the supra-pubic method.

*Median Lithotomy.*—This is applicable to one or more

FIG. 618.

small stones; when the introduction of an instrument into the bladder causes a chill or other disturbance; in advancing puberty; there is less danger from hemorrhage, much better control of the urine from the first, and the wound heals rapidly. If the stone be larger than was anticipated, the temptation to use violence during the extraction is great. It is claimed that it may be followed by stricture, and that the mouths of the seminal ducts are more liable to injury than by the other methods.

The especial instruments required are the staff, director, and knife. The staffs vary somewhat in shape and depth of groove. Those devised by Dr. J. L. Little (Fig. 614) and T. M. Markoe (Fig. 615) leave nothing to be desired. The rectangular variety (Fig. 616) can be used in lieu of the curved ones. It is, however, infrequently used in this country. The director commended by Dr. Little is an admirable instrument (Fig. 617), but is by no means essential to a successful operation. A stout, straight, sharp bistoury, double-edged at the point, for making the perineal incision, makes the especial outfit complete (Fig. 618). Confine the patient in the lithotomy position (Fig. 626*a*); introduce the staff, placing the beak in contact with the stone; pass the left index finger into the rectum and locate the apex, of the prostate just where the staff enters it, introduce the point of the knife into the median line of the perineum half an inch in front of the anus, with the long-cutting edge uppermost and push it carefully upward, guided by the finger in the rectum, to the apex of the prostate, into the groove of the staff. The knife is advanced sufficiently toward the bladder to nick the apex of the prostate, after which it is carried forward to divide the membranous portion of the urethra. The external incision should be from one and one quarter to one and one half inches in length, care being taken to avoid the *bulb* of the urethra. The director is then passed into

FIG. 619.

FIG. 620.

the bladder along the staff, and the neck of the bladder dilated by separating the two. The staff is then withdrawn, and the index finger of the left hand carried through the neck along the staff, with a semi-rotary motion

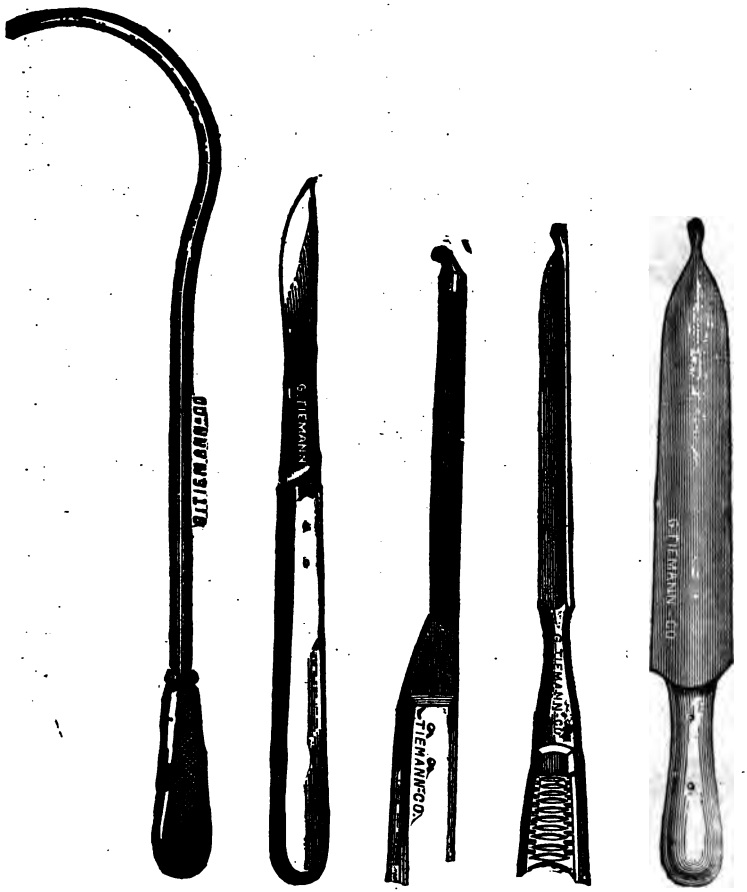
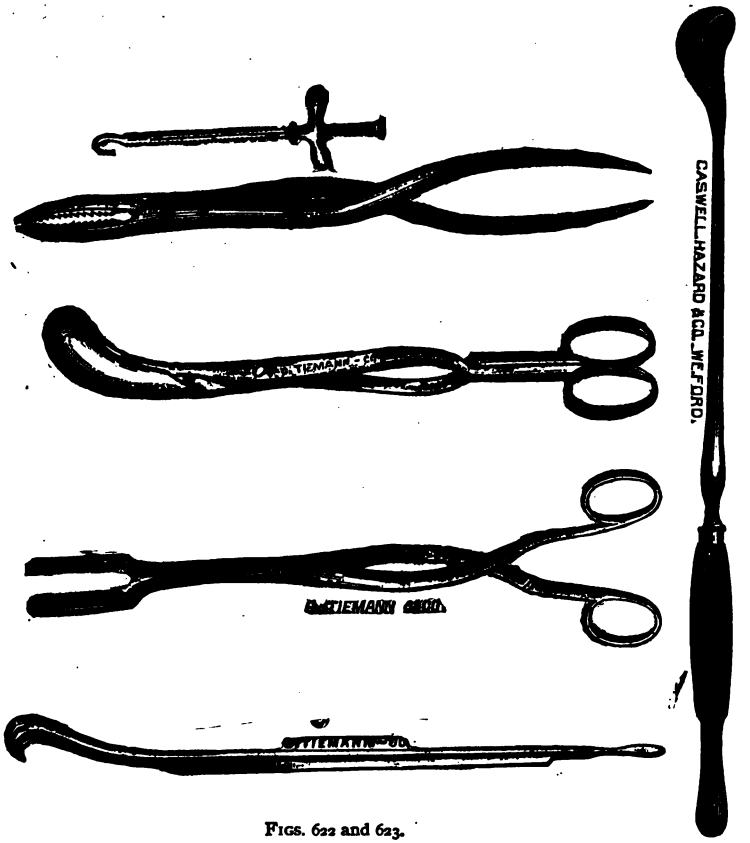



FIG. 621.

to complete the dilatation. The forceps are then introduced, stone caught and removed by steady, gradual traction, which may be accompanied by rocking move-

ments, but never by a rotation of the instrument on its long axis while grasping the stone.

Various instruments have been devised to dilate the prostate in this and various other methods calling for the procedure (Figs. 619 and 620), all of which answer the purpose well, but are by no means essential to the safe




FIGS. 622 and 623.

performance of the operation. After the removal of the stone, stop all hemorrhage, seek for any remaining calculi, wash out the bladder, place the patient in bed with the limbs extended, administer an anodyne, and maintain *quietude*.

*Lateral Lithotomy.*—This method is employed in preference to the median, when the stone is too great for removal through the dilated prostrate. The instruments necessary

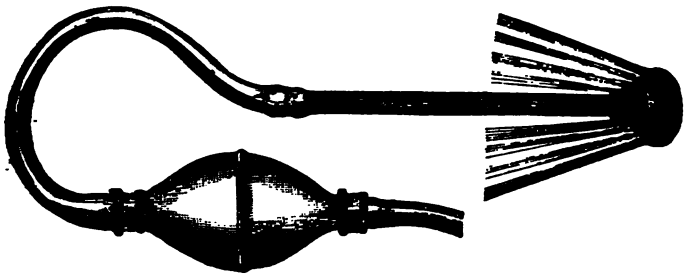


FIG. 624.

for this operation are a staff of suitable size, with the proper curve and a deep groove upon its convexity and approaching its right lateral aspect as it nears the point (Fig. 621); a knife with a stout blade and handle, a solid shank, a sharp

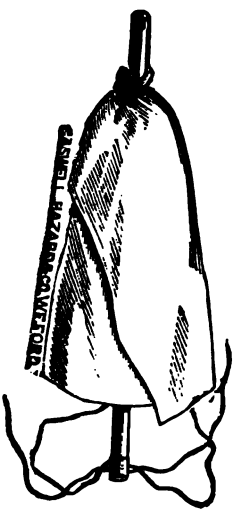


FIG. 625.

point, and a cutting edge of about two inches in length, and a probe-pointed knife—the one devised by Blizard—being the best. If the perineum be deep, due to obesity,

the gorget may be selected. The scoop to dislodge the remaining fragments of stone (Figs. 622 and 623). Forceps of various sizes and shapes to seize the stone, one of which should be arranged with crossed handles to avoid stretching the parts about the neck of the bladder when the stone is grasped. It is likewise well to be provided with a small lithoclast, for the purpose of breaking those stones too large to be extracted with safety; and a syringe to wash from the bladder any small fragments that may remain (Fig. 624). Davidson's syringe can be used, but with less satisfaction than one designed for the purpose. The shirted canula

FIG. 626.

(Fig. 625) is useful to control hemorrhage. At least five assistants, to one of whom should be entrusted the staff; the limbs may be held by another, either with or without their being confined by the anklets (Fig. 626). The hands and feet may be bandaged together satisfactorily for the purpose. The more modern device for separating the lower limbs and exposing the perineum will be of admirable service (Fig. 626*a*).

*Operation:* Shave and disinfect the parts, empty the rectum with an enema, administer an anæsthetic, draw the

patient down to the edge of the table, and confine the extremities. The staff is then introduced and the stone found; a diagnosis which should be verified by others present. If the stone be not found, the staff should be withdrawn, and its presence and location determined by the searcher, facts which should likewise be confirmed by others.

If the stone be not found at all, the operation must be deferred. The principal assistant who holds the staff, should satisfy himself that the sound touches the stone, although it is not necessary that it be pressed against it during the operation. The holder of the staff should stand at the pa-

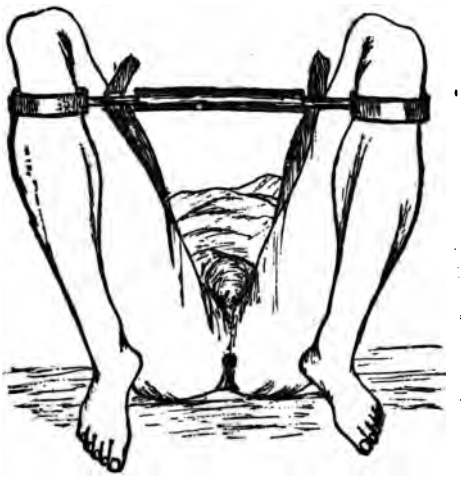


FIG. 626a.

tient's left and press it firmly beneath the pubes with the right hand, while the integument of the perineum is made tense by drawing up the scrotum with the left. The convexity of the staff should be easily felt in the perineum. If the perineum be thin the groove may be indistinctly defined. The surgeon should sit upon a low stool, and before beginning the incision, carefully map out the location of the bulb, locate the point where the cut is to begin, determine the outlines of the rami and tuber ischii. He then carries the index finger of the left hand into the rectum, locates the apex of the prostate, and determines its relations to the

sound. The finger is then withdrawn, disinfected, and the groove in the staff again located. The incision is then commenced a little to the left of the median raphé, from an inch and a quarter to an inch and a half in front of the anus. The point of the knife should be made to enter the groove at the first or second cut, being guided by the nail of the index finger of the left hand. The perineal incision should be from three to three and a half inches in length, and be carried obliquely downward midway, between the tuber ischii and the verge of the anus. The urethra is now

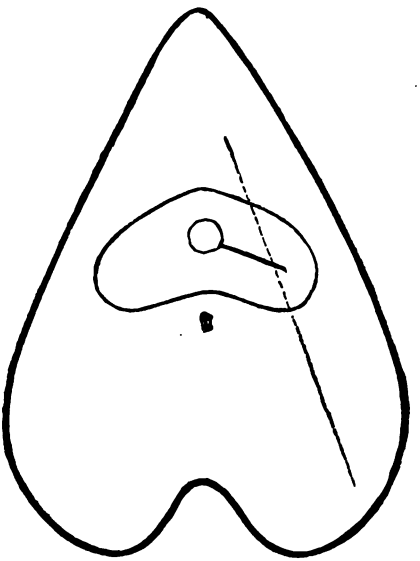


FIG. 627.

freely opened, and the probe-pointed bistoury substituted for the scalpel; or, the blunt extremity of the Blizard's knife is engaged in the groove. When, the surgeon, taking the handle of the staff in the left hand, lowers it somewhat, and holding it firmly carries the knife towards the bladder, depressing its handle slightly to correspond to the curve of the staff. If he were to push the knife downward and backward without depressing its handle the point would leave the staff and pass behind the bladder, a fact

which would not be discovered until the withdrawal of the knife and the attempt to pass the finger into the bladder. As soon as the end of the knife is stopped, by the termination of the end of the groove in the staff, its handle is depressed, the edge turned still more, and the deep tissues severed from within outward by its withdrawal, being careful to make the incision through the prostate more horizontal than that of the perineum (Fig. 627). The flow of urine which follows assures the operator of the successful entrance to the bladder.

It is recommended, and often practised, to press the point of the scalpel firmly against the staff in the groove with the right hand, seize the staff with the left, depress the handle of the staff and knife at the same time, to the same extent, and thus converting them into one instrument which is pushed into the bladder. This modification will prevent the escape of the point of the knife from the groove. It is more difficult, however, to properly lateralize the knife in its passage through the prostate than by the former method, besides, it is much less elegant. The purified index finger of the left hand is now passed carefully into the bladder along the staff, which is then withdrawn. The neck of the bladder is dilated by the finger, the stone reached and its diameter estimated, if it has not been done before. If it exceeds an inch in diameter, the right side of the prostate should be nicked by introducing the knife along the finger. The forceps are now passed in as the finger is withdrawn and the stone carefully grasped in the short diameter. If one blade of the forceps be pressed upon the floor of the bladder and the instrument opened, the stone will often roll within its grasp. However this may be, unusual caution must be employed not to bruise the contracted walls of the empty viscus. If the stone be grasped in its long axis it should be dropped and the direction corrected by the finger carried into the bladder. The change may be accomplished by carrying two fingers into the rectum, separating and pressing them upward against the bladder, thereby compressing its sides and creating a furrow running antero-posteriorly into which the corresponding long axis of the stone will drop. When properly grasped it should be withdrawn by steady traction made in the line of the incision through the perineum. Lateral movements should be made with direct traction. If inordinate traction be deemed necessary for its removal it should be crushed,

after which it can be easily extracted. As soon as the calculus is removed, it should be examined for the facets upon the surface, which indicate the presence of one or more calculi in the bladder. Having removed all of the calculi, irrigate the bladder with tepid carbolized water to remove all blood clots and whatever detritus may be present. If earthy matter exist in the bladder it may be necessary to remove it with a scoop. If the stone be encysted it is very difficult and often impossible to remove it. It may be grasped with the forceps with or without nicking the confining membrane, in either instance great care and judgment must be exercised. If arterial hemorrhage occurs it may be checked by ice-pressure, by the devices previously illustrated, or by the ligature; if these fail, the forceps-serres-fines may be clasped to the bleeding points and allowed to remain. The tying in of a tenaculum, or acupressure will check it; venous hemorrhage may be controlled by the chemise catheter or other similar expedients. After the operation place the patient in bed with a rubber-cloth beneath the hips, separated from the body by cloths to collect the urine and indicate the occurrence of hemorrhage. Give light and stimulating diet, alkaline drinks, and treat all sequelæ on general principles. The rate of mortality ranges from six to ten per cent.

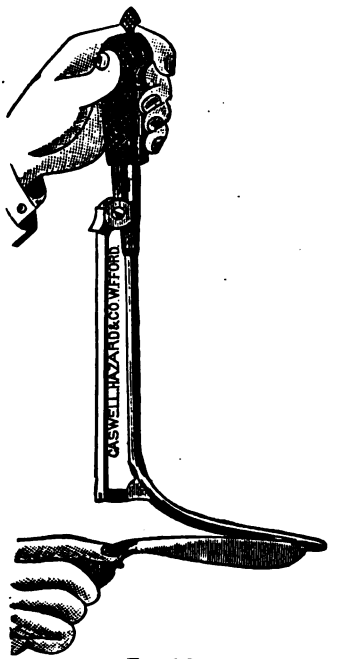



FIG. 628.

The operation as just described is the one usually employed. There are, however, instrumental modifications which may rob it of the little danger, in the opinion of some, which with a careful adherence to the detailed method may arise. That devised some years ago by Dr. Smith, of Baltimore, and successfully employed by him and

others (Fig. 628), is worthy of mention. It consists of a rectangular staff with a well-rounded angle, and deeply grooved on its horizontal portion and provided with an indicator attached to the shaft by means of a hinge. The

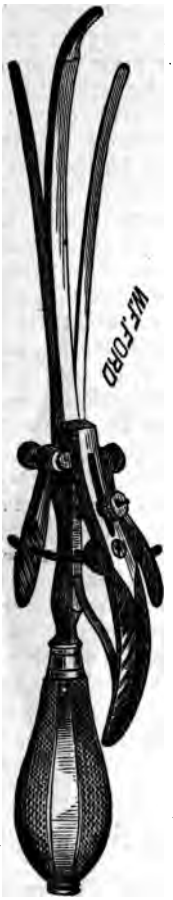



FIG. 629.

FIG. 630.

indicator is likewise rectangular and terminates in a lance-shaped blade. The indicator can be adjusted sliding up and down the staff; or various sizes of the whole may be

employed to meet individual differences. The shaft is introduced and held by an assistant in the usual manner, and the cutting extremity of the indicator is applied to the median line and pushed through the tissues, until it lodges

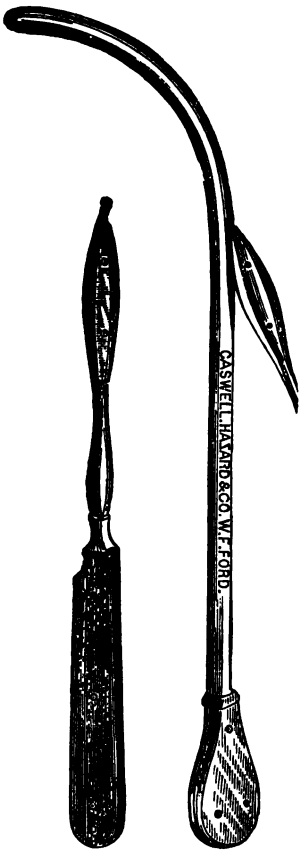



FIG. 631.

FIG. 632.

in the groove of the staff. The probe-pointed gorget is then passed into the grove in the under surface and lodged in the channel on the staff, along which a cut is made into the bladder. A probe-pointed bistoury may be substituted

for the gorget. The single and double lithotome (Figs. 629 and 630) have their advocates, who are, however, in a small minority when compared with the adherents of the scalpel and grooved staff.

*Bilateral Method.*—The preliminary preparations and the general arrangements are similar in this to other methods. The special instruments are the grooved staff and bisector, so intimately associated with the name of the late Prof. James R. Wood (Figs. 631 and 632). The operation consists in making a semilunar incision across the perineum, three fourths of an inch in front of the anus, beginning between the anus and the tuberosity on the right side a little nearer the anus, and terminating at a similar point on the opposite side (Fig. 633). The convexity of the cut is

FIG. 633.

directed forward. The several tissues are divided down to the membranous urethra, which is opened and the beak of the instrument inserted in such a manner as to cause the bevelled edges of the bisector to be uppermost. After moving the beak backward and forward, to be certain it is well lodged in the groove, it is then firmly pressed against the groove in the staff, and, with the staff held firmly, it is carried into the bladder. They may be, practically, converted into a single instrument by pressing them firmly together and carrying them both in at the same time, being careful to depress the handle of each to the

same degree. The bisector may be carried behind the bladder if any tissues exist between the groove and its probe-pointed extremity, or if the handle be not depressed to conform with the axis of the shaft. The results of this method in the hands of Dr. Wood were equal if not greater than those heretofore stated in connection with other methods.

## MEDIO-LATERAL OPERATION.

A method devised by Buchanan, of Glasgow.

The instruments necessary are a rectangular staff with a broad groove in the left side, and a narrow straight knife with a long edge. The staff is introduced, and the prominent staff-angle adjusted to correspond to the mucocutaneous junction of the anterior verge of the anus in the median line.

It is then firmly held with the handle inclined toward the abdomen, and the tissues penetrated by the knife, held horizontally and with the edge turned to the left until the groove in the staff is reached (Fig. 634), when the knife is

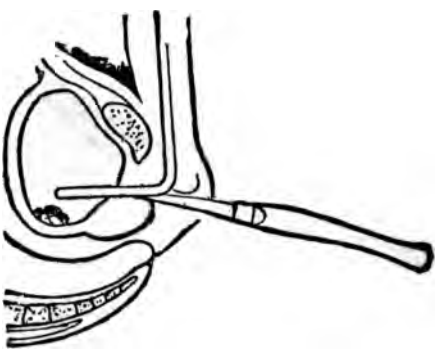


FIG. 634.

pushed forward into the bladder upon the staff. As it is then withdrawn, an incision three fourths of an inch long is made downward and outward toward the fore part of the tuber ischii, which is completed by being continued

directly downward about a half an inch. If necessary, it can be extended.

One in 10.5 cases are reported to have died from this method.

## MEDIO-BILATERAL OPERATION.

This method was brought to the notice of the profession by Civiale, and has since been championed in this country by Dr. W. F. Briggs, of Nashville. The staff for the median method is introduced with the patient in the usual position; the rectum is drawn backward by the finger, and an incision made through the median line into the staff an inch and a half in length, beginning about a quarter of an inch in front of the anus.

The lithotome (Fig. 635) is then introduced into the

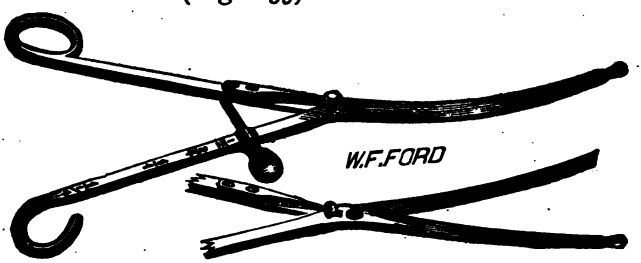



FIG. 635.

groove, carried into the bladder, blade expanded a half an inch, and the instrument withdrawn, enlarging the wound on either side a quarter of an inch throughout. The wound is then dilated and the stone removed in the usual manner. If too large it may be crushed.

Prof. Briggs reports his deaths at the rate of one in thirty-seven cases operated upon, which is truly astonishing.

## SUPRA-PUBIC OPERATION.

The supra-pubic, or high operation, was first done by Frère Côme. It is almost entirely limited to cases of large calculi. It can be utilized if the bladder be not contracted and the patient be not too obese.

The dangers relate to cutting the fold of peritoneum in front of the bladder, and to urinary extravasation.

Place the patient on the back, distend the bladder with tepid water until it is easily appreciated above the pubes. Make an incision in the median line, beginning at the symphysis, three or four inches long down to the linea alba, which is opened by an ordinary scalpel or an aponeurotome (Fig. 636) upward for about three inches, carefully

FIG. 636.

avoiding the peritoneum. The soude a dart is now pressed into the bladder, trocar protruded through its anterior wall and the abdominal opening, bladder opened upon it as a guide; the hooked gorget (Fig. 637) introduced into the opening, which, with the aid of a spatula, enables the wound of the bladder to be opened sufficiently to admit the forceps and remove the stone. If the space be found insufficient, the muscles attached to the pubes may be divided

FIG. 637.

transversely close to those bones. Wash out the bladder, and close the wound in its walls by interrupted catgut sutures, cut short. The abdominal incision is likewise united, and the antiseptic dressing applied.

The bladder should be evacuated once in two or three hours during the first three days; after this it may be done less frequently; and at the end of a week discontinued.

The rate of mortality is about one in four.

## LITHOTOMY IN THE FEMALE.

Aside from the method of crushing, a stone may be removed from the bladder of the female by rapid dilatation of the urethra, and by urethral and vesico-vaginal lithotomy.

The dilatation method is done by aid of the finger or an instrument (Fig. 638) especially designed for the purpose. A calculus an inch or more in diameter can be removed in this manner without unfavorable results. The operation of lithotomy is not of difficult execution.

Introduce a broad grooved director into the bladder, and upon it pass a straight probe-pointed bistoury, and cut directly upward toward the symphysis pubis. Follow this by dilitation, and remove the calculus as before. If a greater space be required, the cut may be extended downward and outward towards the tuber-ischii.

This method is modified by combining the two preceding methods as follows: Dilate the tube first, then cut either its anterior or posterior wall as best suits the indications of the case, and remove the stone.

The vesico-vaginal method consists in simply connecting the vagina with the cavity of the bladder by a longitudinal incision, varying in length according to the size of the stone. A grooved staff is introduced into the bladder, the location of the groove determined, and the intervening tissues divided through the vagina by a scalpel or scissors.

FIG. 638.

The sequel which contraindicates this method is the formation of a chronic fistula. It is claimed this can be prevented and the wound made to heal kindly if the parts be frequently irrigated, to prevent phosphatic deposits; tepid water acidulated with nitric acid will aid materially in the prevention of the deposit.

## OPERATIONS ON THE PENIS AND SCROTUM.

*Hydrocele.*—This morbid process may be treated by tapping, which is palliative, and by incision, excision, and injection.

Tapping is a simple process, requiring for its performance a small trocar, aspirating needle, or something of the same character. The patient is caused to sit upright on the edge of a chair with the limbs separated, the enlargement is seized by the left hand, and the tissues made tense on its anterior surface. The testicle is carefully located, and the course of the scrotal vessels as carefully avoided. The instrument guarded by the end of the finger (Fig. 639) is

Fig. 639.

quickly plunged into the scrotum at about the junction of the middle and lower thirds. As the fluid escapes, the end of the trocar is turned away from the testicle, and the tumor is compressed carefully to exclude the entire fluid collection. After the fluid is removed the scrotum is suspended, and the patient kept quiet, otherwise inflammation of the sac may occur, which, while it may lead to a radical cure, will not be welcome, as it causes much pain and con-

fines the patient to bed. It will be necessary to repeat the operation in five or six months.

*Incision.*—In this the sac is laid freely open on the anterior surface, and the wound dressed from the bottom. It heals in from four to six weeks, and is seldom followed by a return of the trouble. It is of especial efficacy when it is desired to examine the pathological condition of the testicles, with the view of determining the relation of a suspected morbid process to the fluid collection, Volkmann incised the tissues under antiseptic precautions, and stitched the sac to the scrotal incision. This, like the preceding, has been followed by a return of the trouble.

FIG. 640.

*Excision.*—In this, a portion of the sac is cut away on either side of the primary incision. As a modification it allows a freer disclosure of pus, but otherwise makes no practical difference. The external incisions of the preceding methods, may be made either long or short; the former is the better, as it affords more suitable drainage.

All of them can be treated antiseptically with satisfactory success.

*Injection.*—The fluids recommended are various, among which, iodine, sulphate of zinc, and carbolic acid are preferred at the present time. The instruments required in the performance of the operation, in addition to the ordinary trocar, is the rubber injection bag (Fig. 640). The trocar is introduced and the fluid drawn off. It is then seized along with the scrotal tissues to prevent

the escape of its point from the cavity of the sac, and the fluid thrown in by means of the gum bag. If the tincture of iodine be used, it may be diluted with three or four parts of water. Three or four ounces of the mixture is quite sufficient to come in contact with the entire surface. It should be retained for five or ten minutes, until the patient complains of pain, and then allowed to escape through the canula. If the pure tincture be used, a drachm or two injected in the same manner and allowed to remain and be absorbed, is quite sufficient. If the sac be small, fifteen or twenty drops may be thrown into it without the removal of the fluid, by a hypodermic syringe.

If the sulphate of zinc be used, a drachm to the pint of water is sufficient.

A ten per cent solution of carbolic acid crystals and glycerine can be made, of which a drachm or two may be injected and allowed to remain.

The after-treatment in these cases consists in putting the patient in bed, suspending the scrotum, and keeping lead and opium applied to it, with anodynes to allay pain. The congenital hydrocele should not be treated directly until its communication with the abdominal cavity be closed, for obvious reasons.

*Accidents.*—If care be not taken, the fluid may be thrown into the connective tissue of the scrotum instead of the sac. If the canula slip out after the fluid is withdrawn, a fresh puncture must be made, since the previous opening will be closed by the contraction of the dartos. Suppuration, sloughing, etc., which rarely follow, should be treated upon general principles. The results in all the enumerated methods are flattering; yet failures are not absent in the best.

*Castration.*—This operation is simple of performance and free from danger. Shave and disinfect the parts; place the patient upon the back and administer an anæsthetic; make an incision in the long axis of the tumor, beginning just below the external ring and extending to the lower extremity. The tissues are carefully divided on a director down to the cord which should always be cut off short, if the operation be done for malignant disease. The three arteries accompanying it should be tied separately with catgut ligatures. If any doubt exists as to their having been properly secured, the cord should be isolated and transfixed by a needle

armed with strong catgut ligature, and each half tied separately, and the cord divided. If it be divided low down, each vessel can then be tied separately. In cases where it is divided high up, it must be secured before its division,

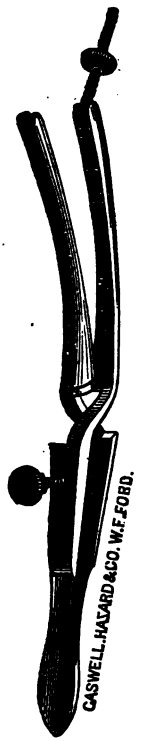



FIG. 641.

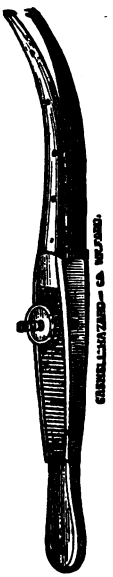


FIG. 642.

FIG. 643.

otherwise it may retract, and seriously complicate its final treatment.

After section of the cord it can be easily removed from its enveloping tissue by the means of traction and an occasional use of the scissors. All bleeding is thus stopped, a small drainage tube is inserted into the lower edge of the

wound, which is united by fine catgut or carbolized silk, and may be dressed antiseptically.

*Circumcision.*—When phymosis or a simple redundency of the foreskin exists, circumcision, or some modification of it should be performed. The instruments especially designed for the purpose, consist of the variously formed clamps (Figs. 641, 642), grooved director, and probe-pointed scissors (Fig. 643). The patient is placed on the back and an anæsthetic administered, unless he express a determination to endure the pain without it. The object of the operation is not to remove the foreskin to the extent of leaving the entire glans penis exposed after recovery, but to allow sufficient to remain to afford the protection characteristic of the normal prepuce. The situation of the base and apex of the glans should be determined, and with a pen or pencil an oblique line drawn corresponding to the direction of the base of the glans, midway between it and the apex, upon the integument. The foreskin is then drawn downward, placed between the blades of the clamp with the line just made corresponding to its lower border, being careful to not include the glans in its grasp (Fig. 644). The clamp is now tightened upon it, and the distal portion severed by a sweep of the scalpel. The clamp is then removed and the integument retracts to, or a little behind its location at the time of the marking, leaving the mucous membrane still covering the glans (Fig. 645, *a*), which is slit up on a grooved director, at the dorsum, *b*, and trimmed symmetrically on either side, not even with the integument *c*, but near enough to it so that when turned over and its free borders are stitched together, a vermillion border at least a third of an inch wide will be formed, *d*. Before the sewing is done, the mucous membrane should be stripped off the glans to behind the corona, after which it can be returned and joined to the integument by a continuous horsehair suture. If the mucous membrane grasps the glans too tightly, endangering the occurrence of paraphymosis, it must be slit on the dorsal surface up to its point of reflection, after which the edges

FIG. 644.

are joined as before. The complete slitting on the dorsal surface will permit it to accommodate itself to the varying dimensions of the penis not infrequently seen during the process of healing.

Another admirable modification (Keyes) which is intend-

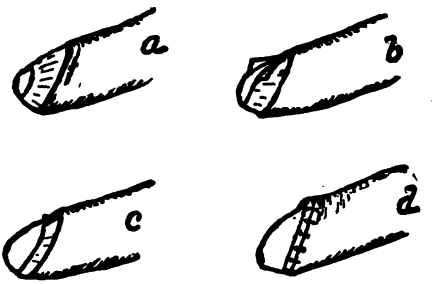



FIG. 645.

ed to meet the same indications is represented by Fig. 646. In this the mucous membrane is reflected backward and joined to the integument, so that 1 shall correspond to 4, 2 to 5, 3 to 6. This does not, however, insure the same freedom as the long dorsal lip just described. If the phymosis be not attended by an elongation of the foreskin, a cure

FIG. 646.

FIG. 647.

may be effected by slitting it upward on the dorsal surface to the base of the glans. The ear-like projections on either side are then trimmed off, and the mucous and cutaneous borders stitched to each other (Fig. 647). Cullerrier accomplished the purpose well in this condition by

subcutaneously dividing the mucous membrane in three or four places by means of a blunt-pointed scissors, the blunt point resting upon the glans, while the sharp one was passed between the membrane and the integument. If the prepuce be short, and the case not an aggravated one, the mucous lining can be stretched, and even torn asunder by means of the blades of the dressing forceps, after which it can be drawn backward and retained until healing is completed. In all the methods of operating, the after-treatment is directed to modifying the inflammation and preventing the occurrence of erection.

For this purpose, cold applications, large doses of bromide of potassium, and anodynes are recommended.

In one case I now recall, local and general medication

FIG. 648.

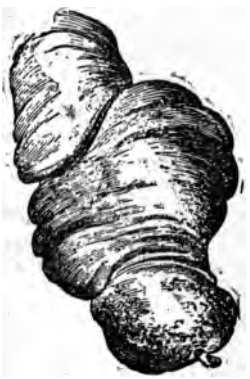


FIG. 649.

combined were not competent to control or hardly mitigate this tendency; yet the indication was met by employing a nurse to watch the penis while the patient slept, with instructions to awaken him at the first alarm.

*Paraphymosis* (Fig. 648).—In this the foreskin is immovably lodged behind the corona glandis, which, if not relieved, causes great congestion and œdema of the parts (Fig. 649), and may even terminate in gangrene and sloughing. The reduction may be accomplished as follows:

Oil the parts well, and administer an anæsthetic, if necessary; grasp the penis behind the constriction with the

thumb and fingers of the left hand and the glans with the tips of the thumb and fingers of the right; press the glans with the latter gradually to reduce the swelling, then draw the constriction forward with the left while the glans is gradually forced through it with the thumb and fingers of the right (Fig. 650). If the constriction be not great and the œdema and congestion be slight, this manipulation will soon effect the reduction. When the part is corrugated and much swollen by long standing severe constriction, followed by inflammation and plastic œdema, it will be found necessary to sever the constriction on the dorsal surface by a sharp-pointed, curved bistoury. In all cases where much

FIG. 650.

œdema exists, acupuncture should be done, and the fluids squeezed through the openings before reduction is attempted. There are other methods of grasping the parts to effect the reduction than the one figured. These admirable illustrations tell the methods more plainly than words (Figs. 651 and 652).

After reduction thoroughly cleanse and disinfect the parts; place the patient in bed with the penis resting upon the abdomen, and dress with cooling antiseptic lotions.

*Amputation of the Penis, Old Plan.*—Place the patient on his back and give an anæsthetic, cause an assistant to retract the integument somewhat, transfix the corpora cavernosa

transversely by an acupressure pin to prevent retraction of the stump, embrace the penis behind the seat of the disease by a clamp (Fig. 653) inclined slightly forward, and

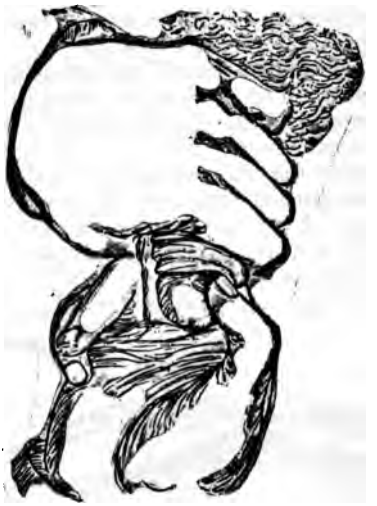


FIG. 652.

FIG. 652.

cut off obliquely downward and forward the projecting portion with a large scalpel; secure all the bleeding points, draw out the mucous membrane of the urethra, divide it

transversely, and stitch it to the integument at four different points to prevent contraction of the canal. If the cavernous bodies bleed too freely it can be checked by acupressure. If the amputation be made too near the pubes to permit the application of the clamp, a tape or cord may be substituted, carried behind the pin.

*Hilton's Modification* consists in dividing the spongy body about a fourth of an inch in front of the cavernous, splitting it longitudinally, and uniting its lateral flaps to the integument as before.

*Humphrey's Modification* consists in dissecting up the skin of the penis and turning back a circular flap about a half an inch in length, dividing the corpora cavernosa on a level with the attachment of the flap, and cutting the spongy body at least half an inch longer than the preceding, and attaching the integument to its extremity.

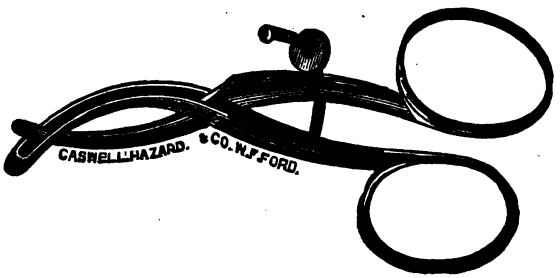



FIG. 653.

*Extirpation of the Penis* (Gouley).—Anæsthetize the patient, make a curvilinear incision on either side of the root of the penis, beginning in the median line about one inch and a half above the level of the pubes and ending a little below the peno-scrotal junction. The cavernous bodies are exposed and transfixed with a large knitting-needle; the urethra is transfixed by a smaller one on the same plane, and the penis is amputated an eighth of an inch in front of them. After all of the bleeding points are secured, the urethra is found and a grooved staff introduced through it into the bladder. A sharp-pointed scalpel is then carried through the perineum and lodged in the grooved staff, and all the tissues, including the skin, divided from before backward. The urethral cut is about an inch and a half in length, and the cutaneous one three inches. The urethra

is now detached from the cavernous bodies, its extremity stitched to the upper commissure of the perineal wound and its sides to the edges of the skin.

*Congenital Malformation of the Urethra.*—The urethra may be absent or occluded; it may be extremely small or bifid; the external opening may be higher or lower than normal and even double; its walls may be deficient above or below, constituting epispadias and hypospadias. Epispadias is sometimes complicated by separation of the symphysis pubis and extrophy of the bladder.

*Hypospadias* results from a deficiency in the floor of the urethra. The opening may exist in the glans, in the penile or scrotal portions. The first is the most frequent and the least important. The scrotal is the next in point of frequency and the most important of all. When the deficiency is in the anterior or balanic portion the following operation (Gouley) will give satisfaction (Fig. 654). Make two longitudinal cuts 2 and 3 far enough apart to leave ample material for the new urethra; make 4 and 5 a fourth of an inch outside; dissect the integument from the spaces bounded by these incisions; leave undisturbed the skin and mucous membrane included between the incisions 2 and 3 at 1 and 10; slide the loose skin at the root of the penis and of the scrotum gradually forward, making it double upon itself until 3, 3 is brought to 2, 2, and the denuded surfaces are brought in accurate apposition, making the angle of the fold at 7, 7. The first suture is taken at 6, 6, passing the upper from within outward and the lower from without inward; before tying pass the suture of the opposite side in the same manner, tie both, cut the ends short, leaving the knots inside the new urethra; connect by sutures along the external borders 3, 5 and 9, and 2, 4 and 8. The newly formed meatus is transverse, its anterior lip being the fold of skin from 10, formed by the apposition of the points 3, 3 to 2, 2. If the opening be in the penile portion, and the organ bent downward, the curve must first be relieved by subcutaneous section of the tissues while the

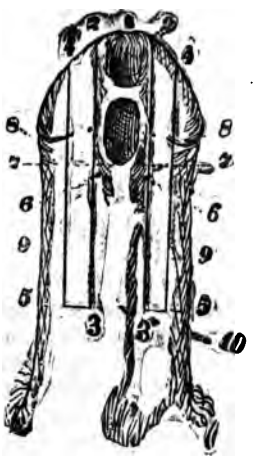



FIG. 654.

penis is being forcibly extended. If transverse incisions of the skin be needed to aid in overcoming the deformity, they will be found to assume a longitudinal aspect when the organ is straightened and can then be united by sutures.

When the defect is in the penile portion the following method is worthy of trial (Anger). (Fig. 655.) Make an incision on the left side of the penis from the glans to the scrotum, 1, 2, half an inch from the median line and parallel to it; from each end of this incision make oblique ones to the median line 1, 3 and 2, 4; the flap thus formed, *a*, is dissected up, its base being attached near to the median line, 3, 4. A second longitudinal incision is made at the right side of the median line, near to it, and of the same

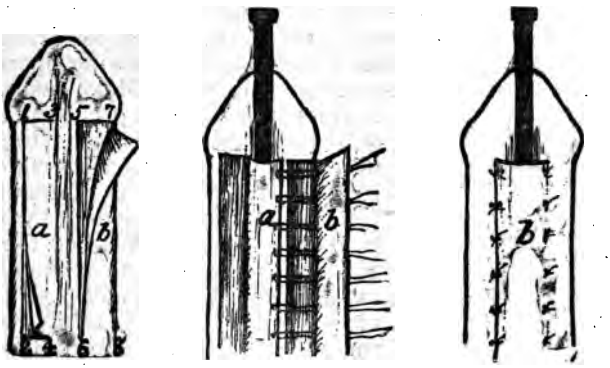



FIG. 655.

length, 5, 6, with lateral incisions at each extremity an inch and a half long, 5, 7 and 6, 8. The flaps are raised, a sound introduced into the urethral groove, and the first flap (*a*) turned over it from left to right (operator's), bringing the integumentary portion toward the urethra. Independent sutures, each armed with a needle, are passed through its free margin and outward through the base of the second flap (*b*), and fastened by shot pressed around them. The right flap (*b*) is then placed upon the raw surface of the first (*a*) and fastened to the margin of the first incision, 1, 2. The sound or catheter is then removed, and only introduced thereafter to evacuate the bladder.

*Duplay's Method* (Fig. 656).—This can be divided into three stages; 1, if the penis be encurved, it is straightened and a new meatus made; 2, the missing wall of the urethra

is restored; 3, the old and new portions are joined together.

The penis is straightened by making transverse subcutaneous incisions through the restraining bands; while the organ is being extended, if the integument be taut, it too must be severed and the resulting cuts united in the long axis of the penis. Some time must elapse after this before the second step of the operation is attempted. The first step

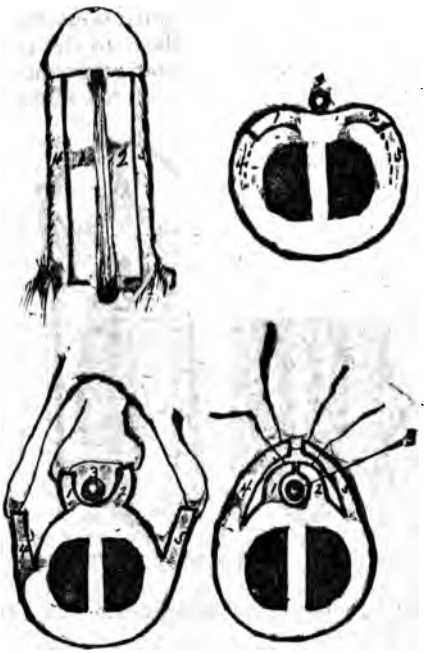


FIG. 656.

is completed by freshening, and if necessary deepening the urethral groove at the situation of the proposed meatus, and uniting its raw surfaces by silver wire or carbolized silk around a piece of gum catheter.

*Second Stage.*—Two longitudinal incisions are made, extending from the glans to near the abnormal opening, one on each side of the urethral groove at a distance from each other, equal to half the circumference of the proposed

urethra, a dimension which can be ascertained by consulting the gum catheter over which the flaps are to be reflected. From the ends of these a transverse incision is made toward, but not quite to, the median line. These flaps are dissected up and turned inward over a gum catheter, and their margins fastened together in the median line by five sutures. The outer lips of the longitudinal incision are dissected up sufficiently to permit their being easily drawn over the reflected ones, when they, too, are united in the median line by interrupted or continuous sutures. Unite the anterior extremities of all flaps to the raw borders of the glans, thus completing the anterior portion of the tube.

*Third Step.*—Freshen the edges of the abnormal opening

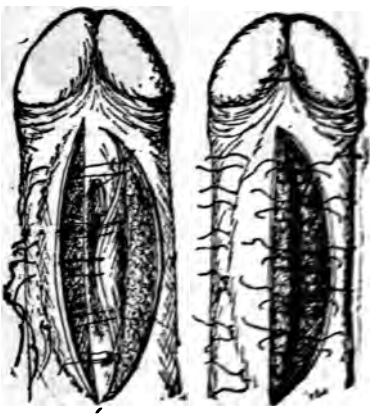


FIG. 657

and unite it to the posterior extremities of the flap by a double row of sutures.

*Szymanowski's Method* (Fig. 657).—Make an incision near the edge of the fistula and extending beyond it half an inch; dissect up a flap bounded by the dotted line; make a curved incision on the opposite side, its length being a trifle less than that marked by the dotted line upon the other, but otherwise of sufficient width to cover the fistula and reach the dotted line when turned upon itself; scrape the cuticle from the deeper flap, and dissect it up to the edge of the fistula; arm each end of a fine carbolized silk suture with a small curved needle; pass these two needles,

about a quarter to a sixth of an inch apart through the edge of the curved flap from its epidermic surface, and pass them from within outward, corresponding to the dotted line, through the base of the flap formed by the straight incision; after passing a sufficient number of these sutures, one to every half inch, draw the curved flap beneath the straight one into the space formed by dissecting up the latter so that its edge will correspond to the dotted curved line, and secure them over a piece of quill or cork. The inner edge of the straight flap is now united to the inner edge of the curved one, and the operation is completed.

FIG. 658.

*Epispadias.*—The ability to secure as satisfactory results in this as in the preceding deformity has not yet been attained.

*Nelaton's Method.*—A ligature is passed through the prepuce, and it is drawn over the end of the penis and held during the operation. An incision is then made along each side of the urethral gutter at the junction of the skin and mucous membrane, beginning at the prepuce and ending at the abdominal wall (Fig. 658) 1 and 2. The external lip of each incision is dissected outward about a sixth of an inch and allowed to remain continuous with the skin; the inner lip of each is likewise slightly detached. A third flap is marked out upon the abdominal wall, its base being located immediately above the abnormal urethral orifice by two vertical incisions, connected above by a transverse one; this flap should be as broad and a little longer than the penis, and dissected from above downward. It is then turned downward upon the dorsum of the penis, the raw surface being uppermost (Fig. 659) and the cuticle forming the roof of the new urethra, K. Its borders, H, are now united by sutures to the inner lips of the incisions on the dorsum of the penis, G,G, the contact being made as broad as possible. The abdominal flap is now reinforced by a scrotal one, F, F, which is limited above by a curved incision circumscribing the under half of the penis at the peno-scrotal junction and below by a curved in-

cision locating the length of the penis below the upper one, each extremity remaining continuous with the integument on the outer surface, E. The flap is dissected up, the

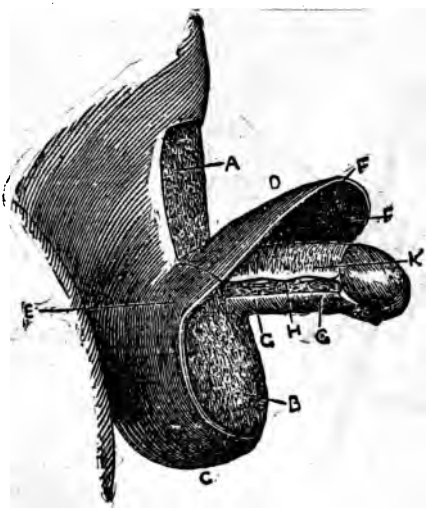



FIG. 659.

penis slipped under it, and its raw surface apposed to that of the abdominal one already in position.

The outer borders of the scrotal flap are now united to

FIG. 660.

same borders of the primary incisions made along the urethral gutter.

*Thiersch's Method.*—This method comprises four distinct steps, and requires several months for its completion.

A fistulous opening should be established in the peri-

neum to permit the escape of the urine before any other steps are taken.

*First Step.*—Formation of a meatus and the portion of the canal occupying the glans.

A deep incision is made along each side of the urethral groove, A, in the glans, the surface of the outer lips of each incision is pared, and they are brought in contact with each other and united by sutures or hare-lip pins, 3 (Fig. 660).

*Second Step.*—Formation of the urethra.

Make an incision through the skin and subcutaneous tissue at the edge of the urethral gutter on the right side, 3, 3; also a short transverse cut outward from each end, 3, 4. Make an incision on the left side parallel with the preceding one half an inch external to the edge of the gutter,

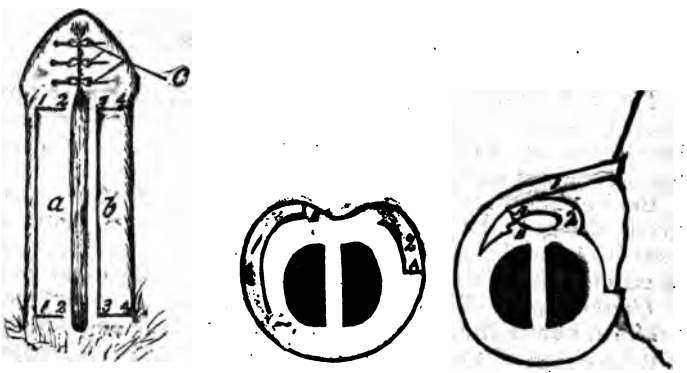



FIG. 660 *a*.

2, 2, and a transverse one at each extremity, 1, 2, extending inward to the border of the groove. The flap *a* is dissected up, making it as thick as possible. The flap on the right side, *b*, is also raised. The flap *a* is now turned over to form the roof of the new channel, its raw surface being uppermost. Several ligatures should be passed through it near to its free margin, in the manner previously shown, thence through the base of the flap *b*, and fastened by a quill or short attachment. The flap *b* is then drawn across the former so that their raw surfaces are in contact throughout, and its free margin joined to the outer side of the left-hand incision by sutures.

*Fourth Step.*—To close the posterior portion of the canal,

This is closed by flaps taken from either groin. The left flap is shaped like an isosceles triangle. Its base is located at the left half of the opening, and when turned downward forms the roof of the new urethra. The right flap is quadrilateral, its base being located at the right external abdominal ring; its raw surface is placed in contact with the raw surface of the fellow, and its borders united by sutures to all contiguous borders. After the healing is completed the perfection of the canal can be tested by temporarily closing the perineal fistula by the finger during micturition. If satisfactory the fistula should be permanently closed.

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## OPERATIONS UPON THE URETHRA.

The walls of the urethra may suffer loss of substance producing fistula. The calibre of the canal may be diminished, causing stricture, either of which usually depends upon acquired causes.

Before attempting an operation for the closure of an urethral fistula the calibre of the canal should be made as near its normal size as possible by appropriate treatment of strictures and such other obstructions as may exist.

*Urethroraphy.*—This method is employed to close small urethral fistulæ, not excluding a fifth of an inch in diameter if it be circular, and one fourth if longitudinal. If reasonable success is attained it is necessary that careful attention be paid to every detail.

Before beginning the operation empty the bladder, and if necessary administer an anæsthetic. A sound is introduced into the urethra and the handle given to an assistant. The edges of the opening are carefully pared obliquely and when completed should present a funnel-shape appearance, the apex corresponding to the mucous opening. The wound should be closed longitudinally by means of a fine wire, horsehair, or antiseptic silk, carried down to, but not through, the mucous lining; the intervals between them being short.

The patient should be kept quiet and given alkaline and demulcent drinks, and the urine drawn with a catheter. It is a wise precaution to inject oil into the urethra before the

introduction of the catheter, to protect the cut from any urine that might come in contact with it.

*Urethroplasty.*—This is employed to close the openings larger than those within the domain of urethroraphy.

If flaps are dissected upon either side and drawn together and joined in the median line, their thickness and

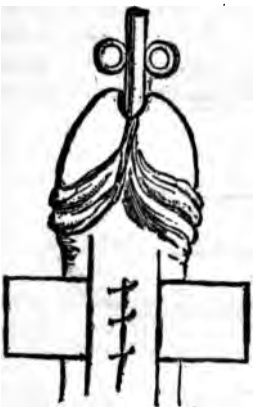

FIG. 661.

FIG. 662.

median contact is very apt to result in imperfect union. To overcome this it has been proposed to pass a sheet of thin rubber beneath to protect them from the urine during the healing process (Fig. 661). If this be substituted by thin rubber skin separated from the cut surfaces by a strip of Lister gauze, the irritation will be lessened and the prospect of success correspondingly increased.

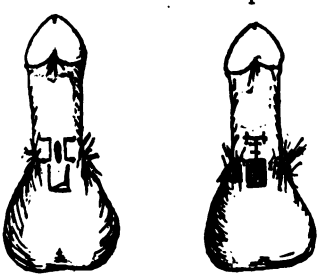

FIG. 663.

*Nélaton's Method* (Fig. 662).—The edges are first pared and then the integument detached subcutaneously for about an inch around it by entering a long thin knife through a transverse cut just below the opening (Fig. 662). The liberated integument is then joined in a longitudinal fold along the median line by means of quilted sutures.

*Dieffenbach,* instead of dissecting subcutaneously, raised

two parallel longitudinal flaps and fastened theirraw surfaces together in the centre by three longitudinal rows of sutures, one above the other.

*Delpech* dissected up a single flap, drew it across the fistula, and fastened it to a raw surface prepared on the opposite side. Arlaud made two transverse flaps, one in front and the other behind the fistula, about an inch and a half in width. The anterior one was dissected up towards the glans about three fourths of an inch, and the

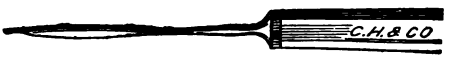


FIG. 664.

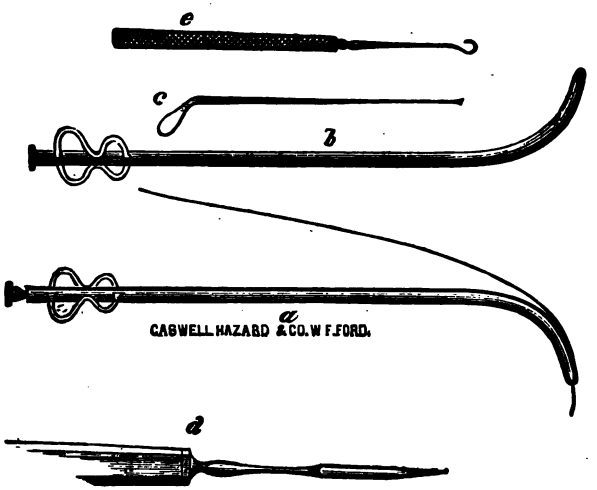


FIG. 665.

posterior one back over the scrotum, until it could be easily drawn forward, so as to cover the fistula. The cutaneous surface of the anterior portion of the scrotal flap was freshened and the flap drawn forward so as to cover the fistula, and the anterior flap drawn backward over it and united by sutures.

*Rigaud* (Fig. 663) closed a large fistula at the peno-scrotal junction by the method employed by Nélaton in the treatment of epispadias. A quadrilateral median flap was taken from the scrotum, its base adjoining the open-

ing, turned it forward over the fistula, and covered its raw surface by two flaps taken from the sides and drawn together to meet in the median line.

Fig. 666.

*Szymanowski* suggested that the cutaneous surface of the reversed flap be blistered instead of scraped. It is not as reliable, however, as the former.

*External Perineal Urethrotomy*, sometimes called perineal section, is employed in the treatment of intractable strictures, especially when accompanied by urethral fistula located in the perineum. It may be performed either with or without a guide. The former is a simpler operation and the latter is frequently an extremely difficult one. The essential instruments are an ordinary scalpel, also one with a sharp point and a long thin blade, and the beaked bistoury of Gouley (Fig. 664), whale-bone guides, grooved and tunneled catheter staff (Fig. 665, *a*, *b*), ordinary sounds, gum catheter, small probe, grooved director, spatula, tenacula, two strong ligatures, each armed with a curved needle, and the usual means of controlling hemorrhage. Symes' grooved staff (Fig. 666) is objectionable, in that its point may get into a false passage and the stricture be missed. Moreover, its introduction through the stricture is more difficult than that of the whale-bone guide and attended by greater danger to the soft parts. If the ordinary small sized grooved staff employed in lithotomy can be introduced, nothing better need be asked for.

*Operation with a Guide.*—Evacuate the bowel, shave and clean the perineum, administer an anæsthetic, fill the urethra with olive oil and introduce a whale-bone guide into the bladder in the manner before described; over this pass the grooved and tunneled catheter staff down and through the stricture, if it can be done readily, if not, allow its beak to rest against the obstruction, carefully supported by an assistant, who at the same time raises and holds the scro-

tum. The patient is now placed in a lithotomy position, and the limbs supported by an assistant on either side. The surgeon, sitting upon a low stool facing the perineum of the patient, introduces the left index finger into the rectum to ascertain the condition of the membranous and prostatic portions of the canal. A free incision from an inch to an inch and a half long is then made in the median line of the perineum, extending from the base of the scrotum to within half an inch of the anus, through the integument and fascia. The grooved instrument is carefully located by the finger and the urethra brought into view by repeated cuts in the same line. The nail of the index finger assures the surgeon of the location of the groove, and the urethra is divided upon it; through each border of the incised urethra is then passed a silk ligature, which is looped and given to an assistant on either side, with instructions to carefully draw the lips of the wound asunder. This important action exposes the mucous wall of the urethra completely, enabling the operator to follow its course by carefully observing the continuity of its structures. The staff is now withdrawn sufficiently to show the black guide and the beaked bistoury is introduced in its course, and the stricture, together with about half an inch of the canal, immediately behind is divided in the median line.

The admission of a grooved director or a small gum catheter through the opening into the bladder, followed by the flow of urine, assures the surgeon that he has located the proper channel; or after the division of the stricture, the tunnelled catheter-staff may be passed along its guide into the bladder, the stylet withdrawn, when the diagnostic urinary stream will escape. The instruments are now withdrawn, and the ordinary sound of suitable size introduced into the neck of the bladder through the urethra to determine the complete freedom of the passage.

*Operation without a Guide.*—After all efforts to introduce the whale-bone guide to the bladder have failed, pass the tunneled catheter staff over a guide along the urethra as far as it will go without using violence, then place the staff and guide in charge of an assistant, as before. Make an incision of the usual length directly in the median line down to and through the urethra into the groove of the staff; pass the silken loops through the borders of the incised urethra as before; check all hemorrhage, withdraw the staff slightly and examine to see if it be located in the tube. The lips or the urethral incision are now drawn

well apart, and the operator, whose patience, care and knowledge must now be well tested, endeavors to introduce a whale-bone guide or a fine probe or grooved director through the stricture into the bladder by way of the perineal incision. If the effort be successful, the remainder of the operation is simple, and consists only in dividing the stricture with the probe-pointed bistoury from above downward as before; usually, however, no anterior opening can be found, or one may be detected which leads away from the median line, showing the existence of a false passage.

In either case the plan of the operator must be the same. Keep in the median line. If, after a patient search, no direct orifice be found, the surgeon feels for the opening in the triangular ligament, through which the urethra normally passes, and cuts toward, and even through it if the urethra cannot be found before. As he cuts he repeatedly seeks for the orifice, and closely examines for a continuity of the fibrous mass in the line of his incision with the tissues composing the walls of the urethra. In the obscure division of the amalgamated perineal tissues, the surgeon also guided by the established relations of the normal urethra to the arch and rami of the pubes to the tuberosities and rami of the ischium, and still more important, to the rectum. The careful cutting and searching is continued until an opening is found which leads into the bladder. The tissue barring the passage is cut, and a small gum catheter is passed along the probe or director into the organ, followed by the welcome flow of urine. The catheter is then withdrawn, the canal dilated with the little finger, and all constricting bands at the roof and floor of the urethra are severed. A steel sound the size of the canal is then introduced into the bladder through the urethra several times until its uninterrupted entrance is assured. Increase the size of the meatus and divide by internal urethrotomy all obstinate strictures in front of the perineal opening. Examine the bladder for stone and if found remove it; stop all bleeding; place the patient in bed with hot fomentations to the abdomen; elevate the scrotum to prevent infiltration; administer anodynes and demulcents, and keep the patient quiet. Suitable sized sounds should be passed every two or three days.

In 8000 cases a little over five per cent died.

*Internal Urethrotomy.*—The division of strictures by cut-ᵍ *instruments* introduced into the urethra is called "In-*nal* Urethrotomy."

It is usually limited to strictures of the penile portion, although sub-pubic and even those of the membranous portions may be divided. The number, size, location, and extent of the obstructions should be determined before the division be attempted.

For this purpose, bulbous bougies and urethrameters have been devised. The metallic bougie of Otis (Fig. 667), and also the non-metallic ones (Fig. 668) meet the indications admirably. If it be the intention of the operator to distend the canal to its fullest capacity, or if the meatus be undersized, it should be slit up before the stricture is divided. The slitting can be easily done by means of the bistouri-caché of Civiale (Fig. 669), introduced into the meatus, cutting surface downward, properly distended and quickly withdrawn. The ordinary probe-pointed bistoury, or a straight-edged one, with the end guarded, will accomplish the aim perfectly. The lips of the cut will unite unless they be kept separated by lint or cotton, or by the occasional introduction of a large sound. The location, number, and size of stricture can be determined by the introduction of bougies. One of large size that will slip through the meatus is selected, oiled, and passed down the canal until arrested. The distance in the canal is noted on the handle. It is then withdrawn and the size of the bulb measured by the usual scale.

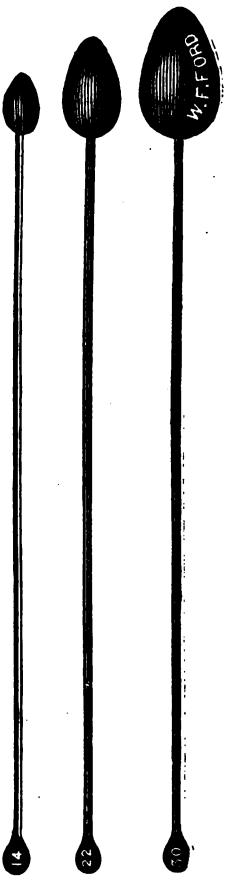

FIG. 667.

The surgeon next ascertains the size of the one that will pass the obstruction, and so on, recording the location and size of each obstruction in its turn until the bladder is entered. The urethrameter of Otis (Fig. 670) is the only one constructed upon a principle calculated to give practically accurate measurements. The expanding blades of the extremity are covered by a small rubber cap or closed tube, *C, the instrument* oiled and carried, closed, through the

last obstruction, if possible, when the extremity is expanded by a screw at the outer end until it fills the urethra, the capacity of which is noted upon the dial; it is slowly withdrawn while the expanded extremity is regulated to accommodate the varied dimensions of the canal; the calibre and location of which should always be noted. By this simple though ingenious method the surgeon is enabled to locate the exact seat of the obstacle he is to treat. The other instruments required are the urethrotome, and a double-barreled catheter, to apply an iced-water current to the canal.

Urethrotomes, like other instruments designed for especial purposes, vary in many important particulars. Those, however, of greatest practical utility, were devised by Otis (Figs. 671 and 672). They bear upon their handle a scale which enables the operator to ascertain not only the size but the distensibility of an obstruction. This instrument, when taken in connection with the urethrameter, enables the surgeon to divide the strictured portions until the dial on the cutting instrument indicates that they correspond in size to the dimensions of the normal portions as indicated by the dial of the urethrameter.

*Operation.*—An anæsthetic is given and the patient is placed upon the back, the well-oiled instrument introduced, and the extremity concealing the blade is carried beyond the obstruction, which is then dilated by turning the screw at the

FIG. 668.

FIG. 669.

FIG. 670.

end until the strictured tissues are made tense, when the knife is withdrawn sufficiently to divide the stricture freely. The

FIG. 672.

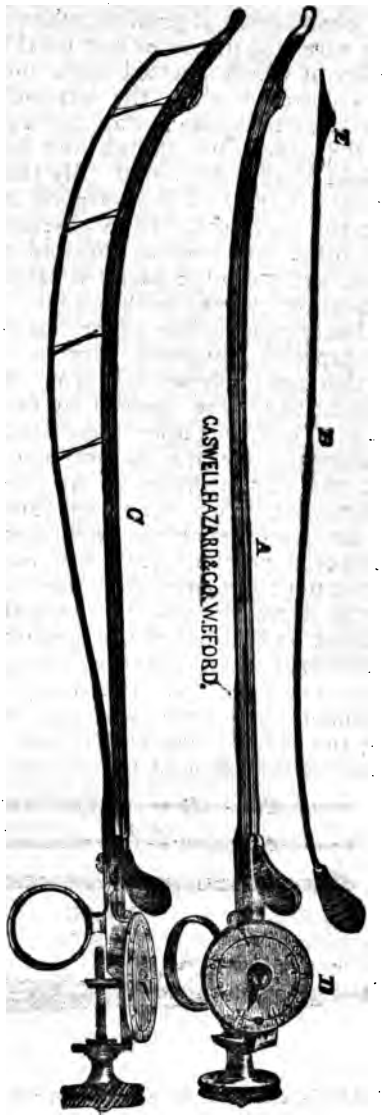


FIG. 673.

action of the screw is then reversed and the knife pushed back into its hiding place and the instrument again dilated to note the effect of the incision upon the calibre of the stricture. If it still be below the standard, as indicated by the urethrameter, the blade is again applied to it. In this manner each constriction can be divided and the tube made of a uniform diameter throughout. If two or more strictures have a common or an almost common diameter, they can be cut simultaneously by drawing the knife along the course of the shaft. There is little danger of cutting the healthy lining, so long as the dial on the urethrotome indicates a smaller dimension than that of the urethra as shown by the urethrameter. If severe hemorrhage follow, a large sized sound can be introduced and the penis bandaged to it. Cold may be applied by means of a stream of iced-water conducted through a double-barreled catheter. It is sometimes necessary to make pressure on the perineum in conjunction with other expedients. The necessity for this is extremely rare. Following urethrotomy the patient must be kept quietly in bed for three or four days, with a light diet and open bowels; demulcent and alkaline drinks are often advisable. A sound may be passed every third day until the wound is healed. Very few patients perish as the direct result of internal urethrotomy, and when carefully done upon proper cases, an unfavorable result need not be anticipated.

## TAPPING THE URETHRA.

In distended bladder from impassable stricture, this is a feasible operation. The patient is placed in the lithotomy position and the left index finger introduced into the rectum and its tip pressed against the apex of the prostate. A double-edged knife is then plunged into the perineum in the median line, the point being directed to the tip of the finger and caused to open the urethra in front of the prostate, behind the stricture, by a slight lateral motion. As the knife is withdrawn the antero-posterior dimension of the wound may be increased. A grooved director is then carried into the bladder through the opening and a catheter passed upon it to relieve the distended

viscus. The opening may be made through the anterior wall of the rectum when objections exist to the perineal puncture.

## PARACENTESIS OF THE PERICARDIUM.

If the pericardium be hyper-distended by fluid, or contain pus, and the attending symptoms denote dangerous heart failure from pressure, the accumulated fluid may be removed by tapping or by aspiration.

The trocar devised by Dr. Roberts, of Philadelphia, who has given much attention to the subject, is suitably adapted to the purpose (Fig. 673). The principal operation should be preceded by an exploratory puncture with a hypodermic syringe. The arteries to be avoided are the mammary and intercostal; the former rests upon the costal cartilages about a half inch from the outer border of the sternum, the latter run along the lower border of the ribs. The point of the instrument should be directed away from the apex of the heart, since the latter moves from left to right and from behind forward at each pulsation.

*Operation.*—Place the patient diagonally upon the left side, with the shoulder and chest raised. Insert the instrument through the fifth intercostal space, an inch or an inch and a half from the left border of the sternum, close to the upper border of the sixth rib, using great care to prevent the entrance of air. Nearly forty per cent of the patients have recovered succeeding the operation.

FIG. 673.

## EXTIRPATION OF THE BREAST.

The breast is removed to eradicate growths of a malignant and non-malignant character. If malignant, the entire gland must be extirpated. If otherwise, only such tissues as are involved in the growth. If the growth be malignant or of a doubtful character, all of the enlarged lymphatics in its

vicinity should be taken away. Indeed, it is wise under these conditions to remove the entire axillary system of lymphatic glands, even though but two or three have become enlarged. The shape and extent of the growth will modify the outlines of the incisions. If it be irregu-

FIG. 674.

FIG. 675.

lar, other than the established elliptical cut may be made (Figs. 674 and 675).

*Operation.*—Wash and aseptacise the part; shave the axilla if the examination of the contents be contemplated; place the patient on the back and administer an anæsthetic.

FIG. 676.

aise the arm to make tense the fibres of the pectoralis major; assume a position relative to the patient which will e most convenient for making the inferior incision first *Fig. 676*). A scalpel of large size is now selected; the

breast pressed upward and supported by the left hand, and the inferior incision made in the direction, if possible, of the fibres or the pectoralis major. It should extend down to the pectoral fibres and be reflected upward from them by traction with the hand, aided by the scalpel when necessary. As soon as the under surface of the tumor is raised, the upper incision is made and the growth removed. The amount of hemorrhage is sometimes quite extensive; still, it can be easily kept under control if an assistant follows the course of the knife with a dry towel, making firm pressure on the bleeding points. Two towels are required, one for each incision. After the removal of the growth the towels are cautiously raised from below upward, and the bleeding points secured by serresfines as soon as seen. Any remaining portions of the morbid growth which may be attached to the pectoral fascia, muscle, etc., should be removed, even at the sacrifice of the parts with which they are connected. The vessels should be ligated with catgut and the axilla examined; if any enlarged glands exist in it, or along the border of the great pectoral muscles they should be removed at once, in connection with all of their associates, irrespective of their size. To remove the axillary glands, the inferior angle of the wound should be extended and great care be taken, else the numerous vessels will be injured. If the glands be isolated they can be enucleated by the finger and handle of the scalpel; if they exist in a mass of fibrous induration, the whole must be removed, which can be accomplished successfully only by a persistent effort, tempered by patient care. The wound must be properly drained at its most dependent part, united with silver and carbolized silk, and otherwise treated antiseptically. The rate of mortality will not exceed ten per cent from removal of the mammary growths and their axillary complications.

If the growth be non-malignant, only that portion of it is to be removed which is involved by it. The mortuary results from limited extirpation are practically similar to those following complete removal. It often happens that the skin is too extensively diseased to admit of the formation of a suitable flap. The wound should be allowed to heal by granulation.

## PARACENTESIS THORACIS.

This operation is done to remove a fluid accumulation from the chest cavity.

The instruments employed for the purpose should be one of the many forms of aspirators. If they be not available the ordinary trocar and canula can be used, due heed being given to the danger of the admission of air. The space through which the trocar should be introduced will depend upon the amount of fluid in the cavity. As a general rule it may be stated that the intercostal space selected should be three or four inches above the lowest limit of dullness. The instrument is introduced nearest to the upper border of the rib, midway between its sternal and vertebral extremities, or on a line with the inferior angle of the scapula. It is very difficult, often, on account of obesity to determine the numerical relations of the ribs. The elevation between the first and second bones of the sternum corresponds exactly to the articulation of the second costal cartilage. The nipple in the male is located usually between the fourth and fifth ribs. If the nipple be normally located a line carried horizontally from it around the chest will pass over the sixth intercostal space in the line of the axilla; if the arm be raised the first visible digitation of the serratus magnus is attached to the sixth rib. The inferior angle of the scapula covers the seventh rib, therefore the first intercostal space below it is the seventh. The eleventh and twelfth ribs can be felt in corpulent persons outside the erector spinæ, sloping downward. If either intercostal space below the seventh be selected, the diaphragm may be punctured if the trocar be inserted incautiously.

*Operation.*—Prop up the patient in bed, or, if able, allow him to sit astride a chair with his arms resting on its back, and his head supported; locate the seat of the proposed puncture and make a small incision through the skin with a lance; insert the end of the instrument, and as soon as the point is engaged in the tissues, extract the air if it be connected with an aspirator, and push it quickly in, guarded by the index finger laid along its side. The thickness of the walls and the presence of fluid must first be determined by the introduction of the hypodermic syringe. All the instruments and the surface at the point of proposed puncture should be well carbolized. The integument over the

intercostal space through which the puncture is to be made must be drawn upward, since, as the fluid escapes from the chest, the space will descend; if this be not done, the puncture through the skin will soon be above the intercostal space. A knowledge of this fact is of immense importance if a permanent opening is to be established, as in empyema. If the puncture be made in the vicinity of the diaphragm the point of the instrument must be directed upward and inward. If the instrument becomes closed by false membrane or floating fibrin, it must be removed by a small wire passed through its lumen. The pulse and sensations of the patient must be consulted during the evacuation to

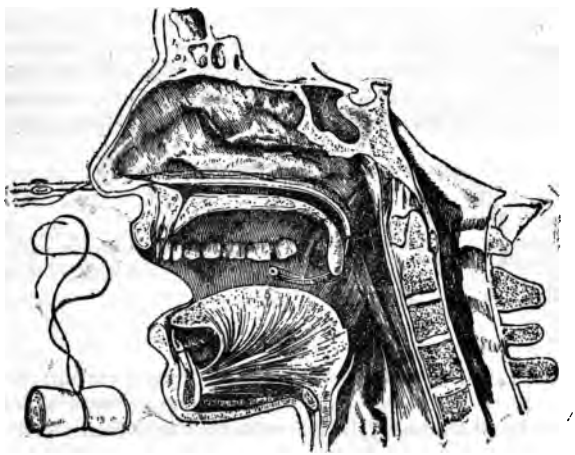

FIG. 677

avoid, if possible, sudden syncope. Death is rarely directly due to this operation.

*Perforation of the Antrum.*—When fluid accumulations occur in this cavity they can be removed by the trephine, or by the ordinary bone drill passed into it through its external wall, or into its bottom through the socket of the first permanent molar tooth, being careful that the drill does not perforate the floor of the orbit. The cavity is then washed out and the opening maintained by the introduction of a gold tube, if necessary, until the function of the mucous membrane is restored.

## OPERATIONS UPON THE NOSE.

*Plugging the Posterior Nares* (Fig. 677).—This is done to arrest obstinate epistaxis. The tampon or plug can be made of sponge, lint, or any suitable cloth, and should be of a proper size to closely fit the posterior naris, which in the adult is about three fourths of an inch long and a half an inch wide. It is made by tying a string around the middle, cutting the ends short, and passing beneath it on opposite sides two strong ligatures, which are looped around and firmly fastened to it by tying. The canula of Bellocq (Fig. 678), with the spring withdrawn, is then carried along the floor of the nostril to the posterior wall of the pharynx, when the movable rod is projected and curves forward into the mouth. The extremities of the loop at one side of the tampon are passed through the instrument and down through the meatus by returning the central rod

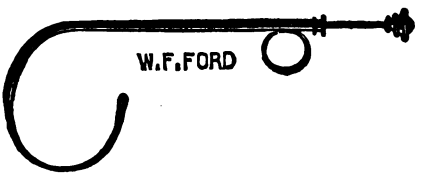


FIG. 678.

and withdrawing the instrument. The tampon is now carried into position by pulling upon the strings aided by the finger carried behind the soft palate. Sufficient traction is made upon it to forcibly close the naris, and the strings in front are tied around a plug of a similar material, which closes the anterior opening. The plug should be well carbolized before its introduction, and, if need be, can be wet with astringent solutions. It should be removed at the end of forty-eight hours, which can be easily done by pulling on the strings remaining in the mouth while it is forced backward by an instrument introduced through the floor of the nostril. If the canula of Bellocq be not available, a long flexible-eyed probe, an ordinary gum catheter, and even common wire may be utilized. Sometimes a string is carried through the nostril by means of the canula and attached to the plug, instead of being tied to it before the *cauula is introduced*.

*Removal of Nasal Polypi.*—If the growths or pedicles be small, they can be quite readily removed by forceps (Figs. 679 and 680) or the snare. If the forceps are to be employed, the patient should sit in a chair, exposed to a strong light, with the head supported by an assistant. The attachment of the growth is seized, and it is twisted

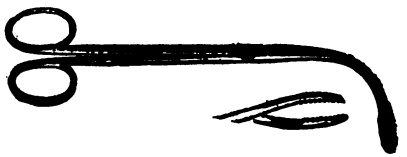

FIG. 679.

FIG. 680.

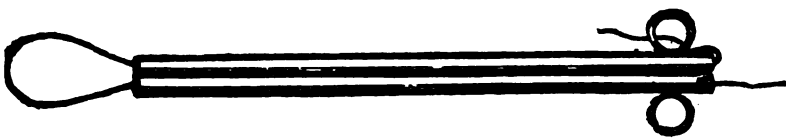

FIG. 681.

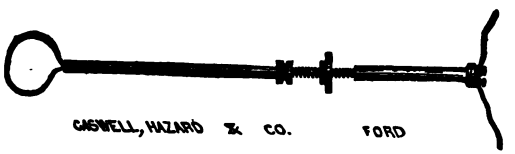


FIG. 682.

off by turning the instrument severel times on its long axis. If the growth be attached to a turbinated bone it may be necessary to pull away some of the bone structure before the tumor can be removed. If the growth be situated far back or hang down into the fauces, it may be detached by the finger passed behind the soft palate. If this fail, it may be snared (Figs. 681, 682, 683, and 684). The wire, either with or without the canula, is passed along the floor of the nose, and the loop passed over the tumor by aid of

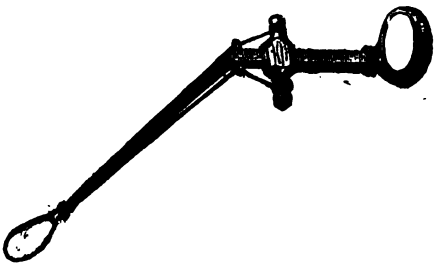

Fig. 683.

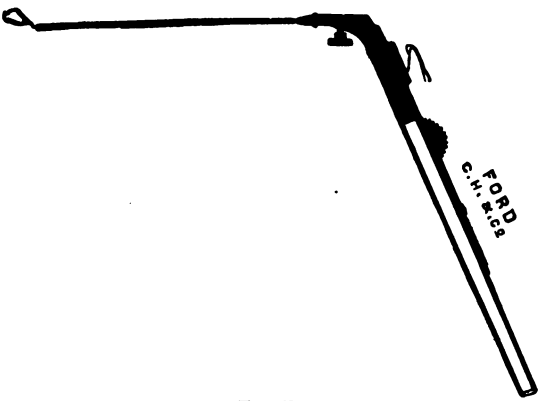


Fig. 684.

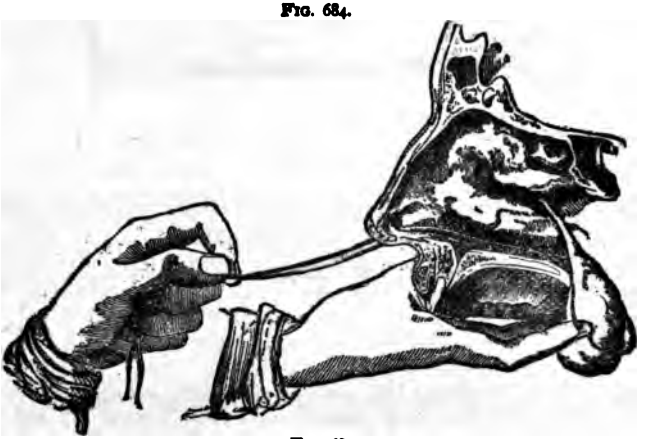

Fig. 685.

the finger if necessary, the loop tightened and the growth severed (Figs. 685 and 686). If the growth be fibrous and not accessible to the previously mentioned methods, it can then be exposed by opening the cavity of the nose. The nose may be turned upward after detaching it on both sides through the alæ at their junction with the cheeks and nasal processes of the superior maxillæ, and in the median line, to the septum. After the removal of the growth the nose is restored to its normal position, and the edges of the wound united. If this method be not deemed advisable the nose can be turned downward (Allier) by making a U-shaped incision on either side through the soft parts and bones from its root to the upper border of the alæ (Fig. 687), and dividing the septum; more space can be gained if one of the nasal bones be displaced

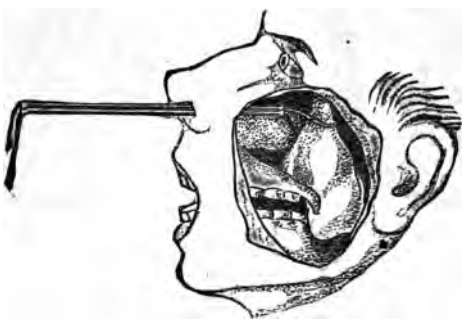

FIG. 686.

(Langenbeck). Make an incision from the junction of the nasal with the frontal bone vertically downward in the median line of the nose to the upper border of the cartilages of the alæ, thence outward upon the cheek. Dissect off the triangular flap, leaving the periosteum; sever the alar cartilage from the nasal bone above, and with bone nippers sever the nasal bone from its fellow. Also in the same manner separate the nasal process of the superior maxilla from its body, when the entire upper part of the nasal cavity can be exposed by raising upward the quadrilateral plate of bone. After the tumor is removed the bone can

be returned and fastened in its proper position. If the tumor be still larger it may be attacked by an opening through the hard palate (Nélaton, Fig. 688). Make an incision in the median line, through the soft palate down to the bone, continue it forward, along the posterior half of the hard palate; two others are now carried obliquely outward on either side from the anterior extremity of the incision along the hard palate to the alveolar process; these flaps, including the periosteum, are reflected out-

FIG 687.

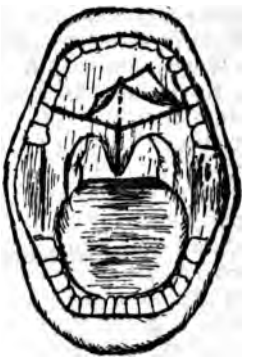

FIG. 688.

ward; the hard palate perforated and cut away, the periosteum and mucous membrane of the floor of the nose turned aside, septum removed if necessary, and the tumor will be exposed to view. The periosteal flap of the hard palate should be returned to the normal position, and stitched after the growth is removed. The cut through the soft palate can be joined subsequently. Naso-pharyngeal polypi may be advantageously reached by this method.

## REMOVAL OF NASO-PHARYNGEAL POLYPI.

*Langenbeck's Method.*—Make a slightly curved incision with the convexity downward from the ala of the nose

along the lower border of the malar bone as far as the middle of the zygoma (Fig. 689). A second incision is made beginning near to the centre of the root of the nose and passing along the inferior margin of the orbit across the frontal process of the malar bone and joins the former at an obtuse angle; these incisions should extend through the periosteum down to the bone, the flaps, however, are not to be elevated; separate the masseter muscle from the malar bone, and with a narrow fine saw divide the bone from within outward along the tracks of the lower incision, its extremity being guided by the finger introduced through the mouth into the posterior naris; after sawing in the line of the lower cut, the saw is turned forward along the upper, and continued forward until the lachrymal bone is reached; the triangular bony flap can now be loosened and pried upward by an elevator inserted beneath the malar bone, thus exposing the growth to ready removal, after which the part is restored to its normal position and the wound in the soft parts closed by sutures. The rate of mortality from this method is less than 25 per cent, and dependent, then, more on the extent of the growth than upon the operation.

FIG. 689.

*Cheever's Case.*—In this both superior maxillæ were removed, owing to the large size and central situation of the growth. He made an incision from near the inner canthus on each side of the nose downward along the natural furrow, around the alæ to the median line of the lip, which he divided. These flaps were reflected upward and outward as far as the malar prominence, and the body of each bone sawn from behind forward to the middle meatus of the nose; the septum and vomer were then cut with scissors; the jaws were then depressed and the tumor removed; after which they are replaced and wired in position. The loss of blood was not great, but the patient died on the fifth day from exhaustion.

*Ollier's Method*, which has already been described under the head of nasal polypi, has been extended by himself to the removal of naso-pharyngeal polypi by carrying a second incision backward from the meatus to meet the

first, thus enabling him to lift a wedge-shaped piece from the jaw, and gain more room. The excision of the upper jaw may be practised for the removal of these growths. The rate of mortality is greater when the operation is done through the hard palate, than by means of the displacement of the upper jaw. The removal of a growth of any great size from the posterior nares or pharynx, especially the latter, will be attended, if its attachment be extensive, by the entrance of a large amount of blood into the pharynx and trachea; it is, therefore, wise to do a preliminary tracheotomy in order that the lower extremity of the pharynx may be closed by sponges, or otherwise tamponed. If the shoulders be elevated and the head allowed to fall far backward the blood can be removed from the dependent portion of the pharynx as fast as it collects; this posi-

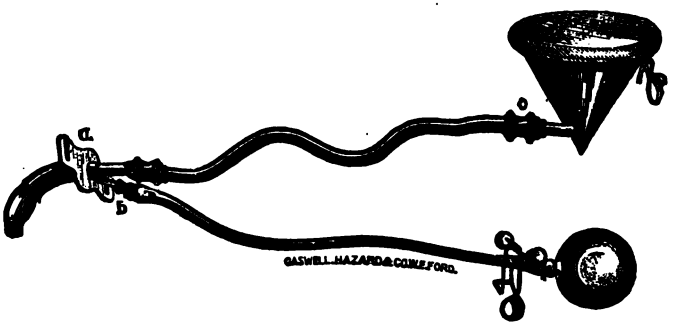


FIG. 690.

tion, however, impedes respiration by over-extending the muscles that act on the os hyoides. If a preliminary tracheotomy be done, the anæsthetic must be administered through the tube. The apparatus devised for this purpose by Trendelenburg (Fig. 690) may be used entire, or the inhaling portion only, can be attached to the ordinary tracheotomy tube; the latter plan is generally to be preferred, since the rubber tampon attached to his tube often causes bronchial irritation when inflated; moreover, if it becomes ruptured during the course of an operation, or be imperfectly distended, blood will enter the trachea unawares.

*Operation for Deviation of the Septum Nasi.*—It not unfrequently occurs that both the bony and cartilaginous portions of the sepm tuare deflected to an extent that seriously

interferes with breathing through the nose during attacks of coryza and likewise imparts a distinct nasal twang to the voice. This deformity may or may not be associated with external modification of the nasal symmetry. In either instance the indication remains the same—to overcome the deformity and to maintain the normal relation of the parts until a permanent correction takes place. The former is done by grasping the abnormal septum between the blades of forceps especially designed for the purpose (Fig. 690*a*)

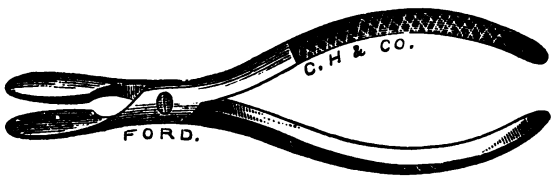


FIG. 690*a*.

which are thrust into the anterior nares and closed upon the septum sufficiently firmly to press its irregularities into a vertical position, held firmly for a few moments, and the resistance still further overcome by cautiously turning the forceps from side to side on their long axis. The pressure exerts a crushing and compressing influence on the tissues of the septum causing it to assume or admit of its being pressed into a normal position. The retentive influence is a purposely constructed clamp (Fig. 690*b*) which is screwed into a position grasping the septum and retaining it in its rectified position. To maintain it thus until the reparative processes necessary to its permanency shall have taken place in the tissues operated upon. The clamp can be permitted to remain two or three days, not tightly screwed—for this would cause ulceration—but sufficiently so to exert a gradual controlling influence. This indication can be well met by introducing rubber tubes of proper size and length, surrounded by oiled lint, into each nostril. These by their elastic pressure answer the purposes of the clamp and at the same time permit air to pass unobstructed through the nostrils. After three or four days either of the preceding appliances should be substituted by ivory plugs (*Fig. 690c*) which are pushed into each nostril and worn

FIG. 690*b*.

at night only. It is true that this treatment is annoying and even attended by positive discomfort, yet the almost assured good result will amply repay the patient for the affliction incurred. If the deviation be great it is recommended to incise the septum and even to remove a sufficient amount to admit of the correction by pressing the cut edges into line.

FIG. 690c.

## BRONCHOTOMY.

This expression includes four distinct operations—laryngotomy, tracheotomy, laryngo-tracheotomy, and subhyoidean laryngotomy. These operations are comparatively easy in the adult, especially if the neck be long and the landmarks well developed; in the infant and the child, and before puberty, the periods of life when they are most demanded, the performance is most difficult, owing to the shortness of the neck, obesity of the patient and the rudimentary condition of the landmarks. The thyroid cartilage, which is well marked in the adult, constituting a prominent point of reckoning, is scarcely discernible in the child, and in the infant it is impracticable to determine its location by physical examination. The cricoid cartilage is the better corner-stone of the two, from which to determine the comparative relations of the parts. It is the distinctive cartilage of the group, and irrespective of age it can be felt as a firm, round ring, much more prominent than the cartilaginous rings of the trachea, which lie immediately below it. The crico-thyroid space, through which the deep incision is made, is located immediately above the cricoid cartilage, between it and the thyroid (Fig. 691). It is situated at the bottom of the first groove-like depression above the cricoid cartilage; the crico-thyroid membrane which is composed of yellow elastic tissue, and is, therefore, of a yellowish appearance, is often dotted by openings for small vessels. When incised, it will retract, owing to its resistant nature; hence all hemorrhage should be stopped before the opening is made, if the urgency of the case will permit. It is not difficult to locate these points in the dead subject under

ordinary circumstances; but in the living, when they are being jerked upward and downward by the efforts at respiration, it is a matter of great difficulty, and may be impossible. The only artery in the line of the operation that need be respected is the crico-thyroid, which runs along the upper border of the space, resting on the membrane of the same name. It is troublesome, not from the amount of blood it contains, but of its relation to the opening in the membrane, through which a small amount of blood may pass into the tube. The vessels causing the

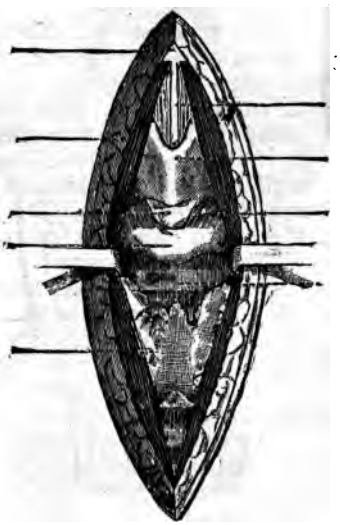

FIG. 691.

greater annoyance, especially if the patient be much cyanosed, are the small venous trunks which run across the region without any established relationship, returning their blood chiefly into the superior thyroid veins (Fig. 692). The anterior jugular veins will be implicated, unless the median line be adhered to. It is unnecessary, I trust, to allude to the well-known relation between the larynx and the large vessels of the neck. The choice of anæsthetics to be given in operations where the respiratory function of the larynx is involved is a matter entitled to some consideration. For

instance, if ether be given to one who has no laryngeal irritation or obstruction, the consequent spasm of those parts is familiar to all. If to these conditions be added the deficient aëration of the blood, due to a laryngeal obstruction, together with the increased tendency to spasm, dependent on laryngeal disease, then is the danger of asphyxia greatly augmented; chloroform may be given with but little danger of causing spasm; if ether be administered, it must be commenced very gradually, to prevent the occurrence of

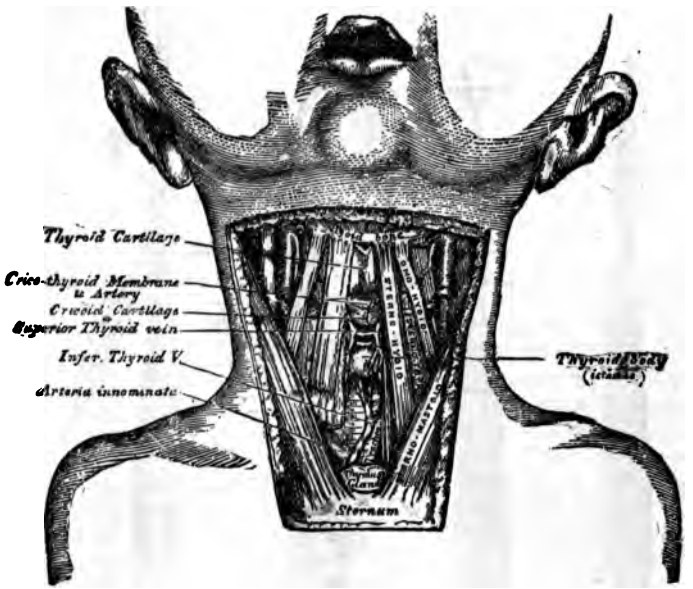


FIG. 692.

spasm. In many instances the pressing nature of the case will not permit the expenditure of the time necessary to produce anæsthesia. In those cases bearing marked cyanosis, the sense of pain is much blunted, and the operation should be done without anæsthesia. The instruments assigned to the purposes of this operation are quite numerous, yet the absence of any one or more should not constitute a reason for its non-performance. When necessary, a pocket-*knife and* a hairpin or toothpick can be extemporized to

better advantage, than allowing the patient to die unaided because a tracheotomy tube be not obtainable.

*Tracheotomy Scalpels.*—One should be sharp and the other probe-pointed (Fig. 693), an ordinary grooved director, retractors (Figs. 694 and 695), and small spatulæ, to draw aside the tissues; tracheotomy hooks, to confine the trachea during its incision (Fig. 696). The last one figured is the

FIG. 693.

FIG. 694.

FIG. 695.

FIG. 696.

best, because the line of the cut can be made between its blades and the centre line of the trachea better assured. There are various forms of tracheotomes, which should not in my opinion be substituted for the sharp-pointed bistoury. They are much less surgical in their inception; dilators, too, are quite numerous and varied in pattern. Trousseau's (Fig. 697), and Fig. 698 are fair representatives of them and

will answer the purpose admirably. The tracheal opening can be easily drawn apart by the ordinary tenaculum or

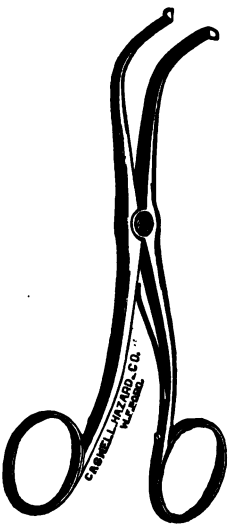


FIG. 697.

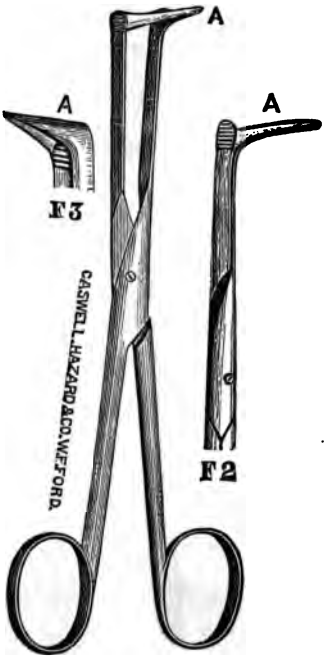


FIG. 698.

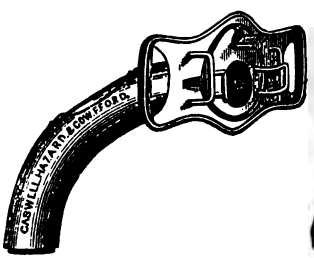


FIG. 699.

FIG. 700.

blunt-pointed aneurismal needles. Tracheotomy tubes of *various forms* are employed. Figs. 699 and 700 represent

those in every-day use, the latter being of hard rubber. Fig. 701 represents forceps for the removal of foreign bodies. A long feather, with the tip of the brush remaining, should be at hand to insert into the trachea through the tube, to cause the expulsion of mucus. A tracheal

FIG. 701.

aspirator has been devised to remove mucus and blood from the trachea (Fig. 702). After the insertion of the tube, place the thumb on the air-hole of the barrel; apply the soft rubber cup over the tube, and withdraw the piston, when the mucus and blood will enter the barrel. It has not infrequently happened that a patient is unable to expel the blood and mucus, on account of stupor or weak-

FIG. 702.

ness, and the lips of the operator were used to suck it from the trachea. This is obviously a hazardous procedure, if the patient have syphilis or diphtheria. The possession of the trachael aspirator will be welcomed as preferable under all circumstances.

*Laryngotomy.*—Place the patient on a table with the shoulders elevated, head thrown back, and neck exposed to a strong light. Three assistants, at least, are required, especially if an anæsthetic be given; locate the cricoid cartilage, and make an incision an inch and a half in length in the adult, terminating at its lower border, and divide the fascia on a director; divide the connection between and

separate the borders of the sterno-hyoid muscles with retractors, push aside the veins and connective tissue, and the crico-thyroid membrane will be seen. If the case be not urgent, check all hemorrhage before opening the larynx. If otherwise, open it at once, when the entrance of air and the resumption of the respiratory functions will dispel the cyanosis and check the bleeding. The opening through the crico-thyroid membrane should be made transversely along the upper border of the cricoid cartilage to avoid the crico-thyroid artery that runs along the upper border of the membrane, near the thyroid cartilage, and also to remove the tube as far as possible from

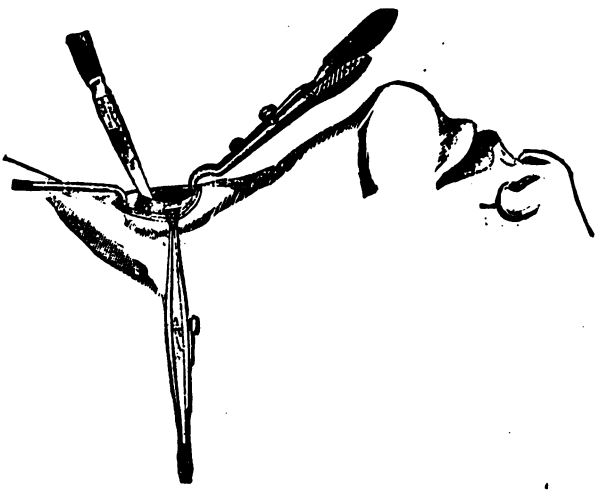

FIG. 703.

the vocal cords (Fig. 703). The larynx is seized and held firmly by a tenaculum while the opening is made; the whistling of the ingoing air, followed by an expulsive cough, which ejects the mucus, blood and other matters follow quickly on the incision. If the operation be done for the removal of a foreign body, it may at this time be expelled, or become lodged near the opening, when it can be removed by forceps. If done for diphtheria the tube should not be inserted until all loose membrane has been *expelled,* and such as may be within reach of the forceps, *pulled away.* If blood escapes into the opening from the

oozing, the pressure of the tube upon the lips of the wound will serve to check it, and for this reason it may be introduced early. The tube is carried carefully in while the borders of the opening are held apart with the orthodox retractor, or by means of two blunt artery needles or tenacula, after which it is fastened in position by means of tapes carried around the neck and tied behind (Fig. 704). The size of the tube is a matter of great importance, since if it be too large it will be difficult to introduce and be followed by ulceration. For four years and under a tube with a calibre of a fourth of an inch is sufficient; four to eight years one third of an inch; and about one half an inch for an adult.

FIG. 704.

The patient is then placed in bed and caused to breathe air saturated with warm vapor from which all floating particles of dirt should be excluded. The tube is carefully watched to prevent it becoming closed, and occasionally removed and cleansed. Too great emphasis cannot be laid upon the necessity of relieving the sudden occlusion of the tube due to false membrane. A momentary inattention, as leaving the room, etc., may prove fatal to the patient. After three or four days it may be removed and the patient allowed to breathe through the opening for a few hours, when it must be again inserted; later in the case it may be inserted only during the night. As soon as the patient can breathe well, the opening should be cleaned, the tube removed entirely, and the opening closed.

*Tracheotomy*, is the operation performed upon children owing to the small size of the crico-thyroid space; it is the preferable operation in all instances when the incision should be made as far as possible from a contagious local disease. It may be done in three situations, above, below, and behind the isthmus of the thyroid gland; the one below the isthmus is to be preferred. The upper portion of the trachea is quite superficial, while the lower is from half an inch to an inch in depth, depending upon the shortness of the neck and the obesity of the patient; moreover, the lower portion recedes, following the curve of the spinal column. The vascular structures in this portion are far more important and numerous than in other parts of its course; the inferior thyroid veins (Fig. 705) and their communications pass in the course of the incision; the arteria thyroida ima when present runs along the centre of the trachea; the arteria innominata, especially in the child, runs obliquely across it, at the root of the neck from left to right. The isthmus of the thyroid covers the second, third, and often the fourth rings of the trachea; above it is seen the communicating branch between the superior thyroid veins; the thymus gland which attains its full size at two years, encroaches upon the space from below upward with each labored respiratory act, and may be incised.

FIG. 705.

*Operation Below the Isthmus.*—Arrange the patient as for laryngotomy, and, if practicable, administer an anæsthetic. Make an incision in the median line extending from the cricoid cartilage to within a half an inch of the top of the sternum; divide the fascia on a director; cautiously separate and pull aside the sterno-thyroid and sterno-hyoid muscles; this exposes the deeper cervical fascia, beneath which are located the inferior thyroid veins (Fig. 705) supported by connective tissue. This fascia should be torn asunder by a blunt instrument, and pushed aside along with the veins and connective tissue beneath, which will expose the trachea. The blunt ends of *two ordinary* directors can be utilized for this purpose, or *instruments* especially devised for dry dissections can be

employed. Throughout the entire operation the tissues must be drawn asunder as fast as separated, by means of blunt hooks or other form of retractors, to afford ample observation of each succeeding part. As soon as the trachea is reached and all hemorrhage checked, it is seized by a hook, the double one of Langenbeck being the best, drawn forward to near the surface of the wound, firmly held, and three or four rings of the trachea divided exactly in the median line from below upward, by a sharp-pointed knife; after which the dilator is introduced, and the tube inserted and confined in position as before; all incisions, except the primary one, must be directed upward to avoid the great vessels at the root of the neck. The opening in the trachea should be long enough to admit the easy expulsion of all false membranes and foreign bodies (even an inch in length is not too much for this purpose), and must likewise readily admit the trachea tube. It is sometimes difficult for the beginner, when surrounded by the turmoil incident to the operation, to be certain of the location of the trachea; if the index finger be inserted into the wound the tube will roll under it, and be felt ascending and descending beneath its extremity, and when sufficiently isolated the rings can be seen and felt. He is also liable to make the opening at one side of the median cut, which makes it difficult to introduce the tube, causes it to bind after introduction, and not infrequently, if the tissues overlap the cut before its introduction, causes air to be forced between their planes, creating emphysema. If the knife be inserted too far, the posterior wall of the trachea will be divided.

*Operation Above the Isthmus.*—Make an incision of the usual length, its centre corresponding to the lower border of the cricoid cartilage; divide and carefully separate the tissues as before; the loop of communication between the superior thyroid veins must be carefully drawn upward; the fascial attachment between the isthmus and the cricoid cartilage divided, the isthmus pushed downward and drawn forward by a blunt hook, when the trachea can be opened beneath it from below upward, and the tube inserted with the same precautions as before.

*Operation through the Isthmus.*—This is hardly of enough practical importance to be entitled to a detailed consideration, since the opportunities afforded above and below it will be sufficient. If, however, this course be selected,

the isthmus should be divided between two ligatures to avoid the probability of troublesome hemorrhage. It sometimes happens that the isthmus is small or too illy-developed to be troublesome after its division.

*Laryngo-tracheotomy.*—In this the larynx and trachea are both opened by a continuous incision, which is usually done to increase the space, that foreign bodies and false membrane may be removed. The incision through the cricoid cartilage and upper rings of the trachea is then secondary to the opening of the larynx. Before the primary incision is extended, the communicating branches of the superior thyroid veins should be pulled downward, the lower border of the cricoid exposed, its fascial connection to the isthmus severed, and the isthmus drawn downward and forward as before. If the tube be too large, too loose, or too angular, it is liable to cause erosions and ulcerations of the trachea, which may extend through it and implicate the vessels at the root of the neck, causing fatal hemorrhage. The method of opening into the trachea by a single incision is fraught with danger, and should not be attempted except the neck of the patient be long and thin, and not even then unless the exigencies of the case call for it. The division of the tissues down to the trachea by means of the thermo- or galvano-cautery has many advocates; it is not, however, the adopted practice of this country. The searing of the tissues is said to prevent or lessen hemorrhage, and likewise to obviate the inoculation of the incision by contagious germs. This is not altogether true, since the large veins which might be otherwise avoided are burned asunder and too often cause severe hemorrhage, which is not easily controlled because of the difficulty of properly securing the cooked extremities of the vessels. The resulting cicatrix is more disfiguring than that following other methods. It is advised in bronchotomy for diphtheria and acute affections of the air passages that the tube be dispensed with, since it can but prove a source of local irritation, and obstructs the exit of false membranes and the secretions. As a substitute, the borders of the tracheal opening can be kept drawn asunder by passing looped ligatures through them, which are united to each other behind the neck. The patient must be carefully watched with this appliance, since, if the head be turned, the opening may become closed. If this prove troublesome, an elliptical piece can be removed from the anterior surface of the tube. If the

piece removed exceed a third of the diameter of the tube, fatal stenosis may follow its closure. But few perish from the direct results of the preceding operations. Bronchitis, pneumonia, hemorrhage from ulceration through the trachea caused by the tube, and primary hemorrhage from wounds of the vessels at the root of the neck, or from an abnormally large crico-thyroid artery, constitute the leading causes of death directly due to the operation. A deeply cyanosed patient, in the tonic stage of anæsthesia, may die, especially if blood be allowed to enter the tracheal opening. In this contingency the blood must be removed at once, and artificial respiration be resorted to. Tracheotomy in diptheria is undoubtedly a most feasible operation and should be performed early, before cyanosis is well established. About twenty-seven and a half per cent perish after brochotomy for the removal of foreign bodies. It is estimated that twenty-five per cent of these cases have been saved which otherwise would have died. It is advisable always to endeavor to extract a foreign body located in either bronchus rather than to trust to nature to expel it. Its site should be carefully determined by auscultation—being more frequently located on the left—before the opening is made in the trachea. After this, if a flexible probe be passed through the opening in the line of the suspected bronchus, it may be easily detected. It may be grasped by forceps of a proper shape and size. A wire with a hooked extremity may be passed by it, and its withdrawal displace or remove the obstruction. A loop of surgical silver wire, as suggested by Dr. J. L. Little, can be pushed past it, turned somewhat and withdrawn with the best of results. In any instance no harm can be done by the wire. A half an hour is quite sufficient time to continue the manipulation.

*Thyrotomy.*—This operation consists in dividing the thyroid cartilage exactly in the median line, together with the crico-thyroid and thyro-hyoid membranes when additional room is desired. Morbid growths and foreign bodies in the larynx, below the false vocal cords, which threaten death from asphyxia and cannot be removed through the mouth, demand its performance. It is wise to anticipate the danger that may arise from the passage of blood into the trachea, by a preliminary tracheotomy, especially if the tumor be a large or a very vascular one.

*Operation.*—Arrange the patient as if intending tracheot-

omy; administer an anæsthetic; make an incision an inch and a half in length in the median line, extending from the hyoid bone downward; divide the fascia on a director; separate the sterno-hyoid muscles, and with a grooved director press aside the tissues beneath, and expose the angle of the thyroid cartilage. If the patient be a child this will be somewhat difficult to discern, even after the exposure; still the centre of the notch at the upper and lower borders of the cartilage marks the extremities of the line of the incision to be made. The cartilage is held firmly by a tenaculum, and the division made exactly in the median line, with a sharp-pointed knife, down to the mucous lining within. If it be divided at either side of this line, the origin of the corresponding vocal cord will be cut. After all hemorrhage is checked, the mucous lining is divided and the lips of the cartilage wound separated by hooked retractors, and if need be, the excision extended through the membranes above and below. The obstruction is then removed and the cartilage accurately apposed and united by fine catgut; the soft parts united and treated antiseptically. If the cartilage be not accurately joined, the functions of the vocal cords will be impaired, owing to their abnormal relations to each other. If the cartilaginous ridge be nicked transversely before its division, it can be accurately apposed thereafter by joining the nicks. Nearly eight and one half per cent die from the operation.

*Sub-hyoid Laryngotomy, or Pharyngotomy.*—It is admissible for the removal of foreign bodies and morbid growths situated high up in the passage, and the relief of abscesses at the base of the epiglottis.

*Operation.*—Place the patient as for laryngotomy; administer an anæsthetic, and make an incision an inch and a half or two inches in length transversely along the lower border of the hyoid bone. The integument, fascia, platysma, and the inner portions of each sterno-hyoid muscle, and finally the thyro-hyoid, are divided on a director. The only vessel contiguous to the incision is the superior thyroid artery, which runs along the upper border of the thyroid cartilage, parallel with the incision. As soon as the thyro-hyoid membrane is cut, the epiglottis will project through the opening, and must be drawn aside, when the tumor will be exposed to view. After the removal of the growth *the* wound is closed and dressed antiseptically. The ma-

jority of the conditions calling for this operation can be satisfactorily treated through the mouth.

*Laryngectomy.*—The removal of the entire larynx is not a difficult operation if the surrounding tissues be not involved. Make a vertical incision in the median line from the hyoid bone to the second ring of the trachea; free the sides of the larynx from its muscular attachments without opening into it; draw the trachea forward with a hook and separate it transversely from the larynx; a syphon tube of vulcanite is then introduced, or the Trendelenburg tampon, to prevent the entrance of blood, and at the same time a proper channel for the use of the anæsthetic. If there be much oozing of blood the head may be lowered to cause it to flow from the trachea, when the posterior and upper connections of the larynx are severed. The œsophagus must be carefully located or it may cut. The tissues should be separated by the fingers when possible, aided by a blunt-pointed scissors. The amount of hemorrhage is trifling and easily controlled; the branches of the superior and inferior thyroid vessels furnish the principal bleeding points. The after attention consists in keeping the parts thoroughly cleansed; regulating the temperature of the room; together with careful attention to the tracheal tube. It often happens that in addition to the larynx, the hyoid bone, base of the tongue, pharynx, and œsophagus, are involved in a malignant growth. The first step under these circumstances is to introduce the tampon canula of Trendelenburg, or a substitute, through which the anæsthetic is administered. Make a transverse incision through the skin from the inner edge of one sterno-mastoid muscle to the other, passing a half an inch above the hyoid bone; from this carry a second one vertically downward along the median line of the trachea to the incision made to open the trachea; turn the flaps outward; remove all large glands in the vicinity; divide the muscular attachments to the hyoid bone; tie the lingual and superior thyroid arteries; excise the tongue below the disease, along with the palato-pharyngeal arches if necessary, carefully avoiding the external carotid arteries, if possible; if not, draw them forward along with the pharynx and divide them between two ligatures; cut the lingual and hypo-glossal nerves. The larynx is now separated from the trachea by cutting the latter just below the cricoid cartilage; a canula is introduced into it; the parts thoroughly washed with a car-

bolized solution; the flaps placed in contact with the raw surfaces without sutures, and the wound dressed with antiseptic solutions. If the œsophagus be divided its lower extremity must be kept open and so placed that it can be protected from the entrance of discharges, and become an available channel through which to nourish the patient. The prognosis of complete extirpation is better than the partial. In speaking of the results Prof. S. D. Gross says: "of thirty-seven complete excisions nineteen recovered and eighteen died, at periods varying from ten to sixteen days, the cause of death in twelve having been pneumonia. Of the entire number thirty were for carcinoma, of which sixteen perished from the effects of the operation; seven died of the recurrence of the disease in from four to nine months; one died from an accident, and six were still living." After the extirpation of the larynx its place may be supplied by an artificial appliance which, although ingenious, serves as a poor substitute for the normal parts.

*Removal of a Goitre* (Watson).—When the patient is in danger of suffocation it is admissible to attempt the removal of the growth, which is done in the following manner: Patient is placed in the dorsal position with the head so situated as to afford the best opportunity of breathing; carefully administer an anæsthetic; make a free incision in the median line from the upper part of the growth to the sternal notch; divide all the tissues on a director in the line of the incision down to the capsule; draw aside the muscles covering the growth if its size will permit, if not cut them transversely on a director, secure all bleeding points as fast as seen; separate the cervical fascia from the capsule of the tumor with the fingers, down to the thyroid arteries which must be ligatured. All fibrous connections between the capsule and the fascia should be tied before they are cut. The capsule can now be opened and its attachments to the growth severed by the scissors. If the capsule be opened before the arteries are ligatured, the hemorrhage will be profuse and the ability to control it limited. After all hemorrhage has ceased the wound is closed with carbolized sutures, and dressed antiseptically. The chance for the life of the patient is flattering; since the plan of operation just described has been practised, less than seven per cent have died.

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